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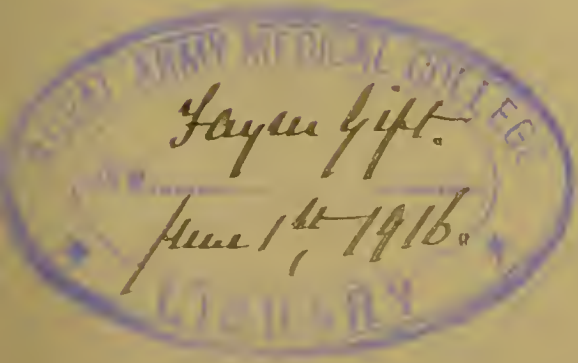
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To

Sir Joseph Fayrer, K.C.S.I.

With the Author's

Compliments.



MALARIA:

ITS

CAUSE AND EFFECTS.

East India United Service Club,
London. S.W.

19th Nov^r 1880

My dear Sir Joseph Fayrer,

Will you do me the favour
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"Malaria and the Spleen" which
Messrs. Macken & Spink have lately
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I send this copy to your house,
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Indian Med Service - of which you
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hope you accept the book.

It is the result of many years
of hard work & constant observation
in a region specially rich in
cases due to malaria. In the
earlier part of the book I have

endeavour to summarise what
is admittedly known about Malaria
and to combine, & work in with this,
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and directions - I know you will
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MALARIA:

ITS

CAUSE AND EFFECTS.

MALARIA AND THE SPLEEN.

INJURIES OF THE SPLEEN: AN ANALYSIS
OF THIRTY-NINE CASES.

BY

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PEACE CALL

✓ RUS

TO
SIR STEUART C. BAYLEY, K.C.S.I.,
CHIEF COMMISSIONER OF ASSAM,
THIS TREATISE
IS,
BY PERMISSION,
RESPECTFULLY DEDICATED
BY HIS OBEDIENT SERVANT,
THE AUTHOR.

P R E F A C E.

THE present treatise embodies the results of much careful observation and reflection carried on during a period of seven years' medical practice in one of the most malarious regions of India—Lower Assam.

Part I treats of the facts tolerably well ascertained concerning the origin and mode of propagation of malaria, the organs specially affected by it, and the consequent lesions of these organs. The portion of the work treating of the true scope and meaning of the term Periodicity, and of the exact and limited sense in which alone this term must be used, to be at all specially descriptive of, or applicable to, truly malarial affections, may be found of interest during the discussion, at present going on, as to the true and precise nature of certain of the pyrexial diseases met with in India and elsewhere.

The Chapters in Part I, embracing the discussion of the theory of the mode of action of malaria, and of the theory of its periodicity, are, as they deal with hypotheses, necessarily speculative. These portions of the work, therefore, cannot rest firmly on the basis of ascertained fact, as the other portions of the treatise may justly claim to do.

Part II of the volume contains, and is founded on, the observed facts of numerous recorded cases of Injury to the Spleen which have come under observation in the above-named district.

The writer hopes that the various analyses of the facts of these records, and the deductions drawn from them, may be found useful for medico-legal reference on questions so frequently cropping up, with reference to these subjects, in Courts of Law, which points can be more logically and authoritatively settled by an appeal to collated records and relevant facts than by any speculative opinion or *ex cathedra* assertion.

In order to facilitate reference on any special point or bearing of the subject, the details of these cases have been analysed and discussed, as fully and exhaustively as possible, under each separate heading and point of view.

This method of procedure has considerably increased the labour of the author, and has—perhaps justly, but he trusts excusably—laid him open to the charge of redundancy.

Since this treatise was sent to the press, Professors Klebs and Tommasi have published the results of their very valuable researches into the nature of the material poison of malaria. Their experiments seem to conclusively demonstrate what was before a merely hypothetical supposition, *viz.*:—that the active poison of malaria is *de facto* a lowly-organised fungoid growth.

The Theory of the Mode of Action, and of the Periodicity, of Malaria, which were thought out and built up

previous to the identification of the Malarial poison, are, however, in no way invalidated on account of the discoveries of the two Roman *savants*; but acquire a new interest, now that the theory as to the nature of the material of the paludal poison has advanced from the stage of hypothesis into that of demonstrated fact.

The writer offers this treatise to the public, as an attempt to assist in developing the literature of a subject by no means written out—an endeavour to endow with interest and practical issue a subject often considered wanting in the elements of real utility—and an embodiment of the results of much continuous and honest work.

GAUHATI, ASSAM ;

The 10th April, 1880. .

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Part II.

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ERRATA.

Page 14, line 9 from bottom, *dele* ' to. '

- „ 18, line 4 from top, *read* ' 230,' *for* ' 180.'
- „ 18, line 6 from top, *read* ' 5,000,' *for* ' 4,600.'
- „ 18, line 9 from top, *read* ' 1,760,' *for* ' 1,300.'
- „ 32, line 5 from top, *read* ' hyperæmia,' *for* ' hypercæmia.'
- „ 36, in second marginal head, *read* ' appear,' *for* ' disappear.'
- „ 44, line 2 from bottom, *read* ' hyperæmia,' *for* ' hypercæmia.'
- „ 47, line 6 from bottom, *read* ' trabeculæ,' *for* ' trabeculæ.'
- „ 48, line 15 from top, *read* ' trabeculæ,' *for* ' trabeculæ.'
- „ 67, line 10 from top, *read* ' anæmic,' *for* ' ancæmic.'
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PART I.



MALARIA AND THE SPLEEN.

PART I.

MALARIA.

CHAPTER I.

MALARIA CONSIDERED GENERALLY.

THE poison, or miasm, known as malaria, has not yet been definitely isolated or identified, as indeed have none of the so-termed “poisons,” infections, &c., producing specific diseases, such as smallpox, scarlatina, typhus, typhoid, or cholera.

The poison of malaria not yet isolated :

Malaria, like these other poisons, is, however, sufficiently well known in its effects.

is known by its effects.

It is believed to be due to some lowly organised cell-form—possibly fungoid, possessed, like many of these low forms of life, of immense vitality and power of rapid reproduction in certain circumstances.

The poison probably due to some fungoid growth.

The production of this miasm seems to depend on the decomposition of organic matter, in the presence of permanent moisture of the soil and humidity of the atmosphere.

Production of malaria ;

The malarial miasm seems formed chiefly during the decomposition of organic matter of vegetable

of typhoid.

origin, just as the typhoid type of poison seems produced by fermentative decomposition of organic matter of animal origin.

Influence of
tempera-
ture.

Malaria in
temperate
climates:

England.

France.

Italy.

The production of malaria, and the intensity of its action, are both favoured by a high temperature, though malaria abounds also in swampy regions, in temperate or cold latitudes. The malarial regions of England are well known :—The fens of Lincoln and Cambridgeshire, the marshes about the contiguous bounds of Kent and Sussex; the northern parts of Kent, about the Isle of Sheppey, and the marshy tracts bordering on the river Swale; the neighbourhoods of Milton, Long Sutton, and Holbeach. In France the Landes—low-lying sandy tracts—have equally acquired a deserved celebrity as malarious regions. The Campagna—low-lying marshy lands bordering on Rome—are even more celebrated for their severe paludal fevers.

True remittent fevers, due to an intense and active condition of the poison, are rarely met with in England or France.

Condition
of tem-
perate
malarial
regions.

All these regions are essentially marshy, the water lying permanently on the surface, or close beneath it; and the soils are largely impregnated with organic matter. The soil of the “Landes” contains much vegetable matter, and the water from the vast plain has a marshy smell.

The
writer's
personal
experiences

The writer has sufficient reason to recollect these malarial English marshes, as he there suffered, for

some months, from a severe form of Tertian ague, which only subsided on his removing from them.

in temperate and tropical malarial regions.

Strange to say, during a residence of nearly seven years in one of the most malarious regions in India, he has not suffered from any distinctly malarial fever.

In many regions of England, from which ordinary malarial intermittent fever has almost entirely disappeared, owing to improved drainage and water-supply—but in which, in pre-sanitary days, agues were notoriously rife—there still prevails, in a marked degree, a form of fever partaking of the nature of true malarial-intermittent and of typhoid, known as paludal-enteric, or typho-malarial, fever.

In ancient ague-beds paludal-enteric fever still prevails.

In speaking of this form of fever, Professor John Harley says, that this is the most common form of enteric fever—that it arises from putrescent animal and vegetable substances—that it is not contagious—and that numerous observations which abound in medical literature form irresistible evidence of the close connection of malarial-intermittent and typhoid. He adds that—"In the low-lying districts on the banks of the Thames, within and about the metropolis where ague was formerly so rife, enteric fever prevails continuously, becoming very abundant in the autumn, while the higher situations are comparatively free from it."

Notes on paludal-enteric fever.

Areas of origin.

And further he notes—"We acknowledge as modifications of the same disease"—paludal-enteric—that intermittent form to which, when London had

Cause of death of James I and of the Prince Consort.

“its cesspools and pumps, and retained all its filth
 “within its undrained area, James I fell a victim,
 “and that continued modification which still lingers
 “in a subdued form in the same locality, and to
 “which a good Prince has succumbed in our gene-
 “ration.” (R. Reynolds’ Medicine, Vol. I, p. 398.)

Facts
known
about
malaria.

The facts tolerably well ascertained about malaria have been summarised by Professor Maclean, in Vol. I, Russell Reynolds’ “System of Medicine.”

Professor Maclean notes :—

Elements
of produc-
tion of
malaria :

“Malaria is the product of organic decomposition
 “in soils, whatever may happen to be their mineral
 “composition ; water is essential to the process,
 “and a high temperature, though not absolutely
 “essential, greatly aids it.

in marshes ;

“It is generated in greatest abundance in marshes
 “which contain a high percentage of organic matter ;
 “hence the name by which it is familiarly known,
 “*viz.*, ‘marsh miasm.’

in arid-
looking
plains, with
water close
to surface.

“It is often found in sandy soils and arid-looking
 “plains devoid of vegetation ; but, in all such cases,
 “the soil will be found to contain a considerable
 “proportion of organic matter, and water will be
 “found not far from the surface, either in the shape
 “of subterranean streams, or detained by a bed of
 “clay below the sand, preventing its free passage
 “and keeping up evaporation.”

Example,
Walcheren.

In the unfortunate Walcheren expedition this was forcibly illustrated, as it still is in the “Landes.”

“Malaria is also generated in hard rocks, such as granite and trap, in a disintegrating state. A notable example is the island of Hong-Kong, which consists entirely of weathered and decaying granite. In such soils, so long as they are undisturbed, the existence of malaria may not be suspected. In the case of Hong-Kong, for example, it was not till extensive excavations into the disintegrating granite were made, for building purposes, that violent and fatal remittents appeared.”

Malaria generated in disintegrating igneous rocks.

Example, Hong-Kong.

This disintegrating granite, though not containing a large amount of organic matter, is especially liable, to be permeated by a peculiar fungus.

Fungoid theory.

“Malaria acts with the greatest intensity on the human system in situations which are low and moist, abounding in vegetation undergoing decomposition, as in jungly districts, during, or immediately after, the rainy season, at the bases of great mountain ranges, and in those belts of country in India termed terrais, formed by the debris of mountains, rich in organic matter, which retain a large quantity of water, and are covered with jungle.”

Conditions most favorable for the generation of malaria.

In Lower Assam we have all the elements for the production of malaria in an intense form.

Elements of production of malaria in Lower Assam.

The lower part of the Brahmaputra valley may be considered as, more or less, the terrai of the mountain ranges bounding it on the north and south.

The soil of this valley consists of a rich alluvium, largely impregnated with vegetable organic matter.

Rich alluvial soil.

Water kept
on surface
by beds of
clay.

Beneath this surface-soil, in the lower part of the valley, lie beds of yellow plastic clay, which maintain the subsoil water close to the surface.

Permanent
marshes.
Giant
jungle.

A large portion of the area of this district (Kamrup) consists of extensive marshes and tracts covered with grass jungle of luxuriant growth, often attaining a height of 20 to 25 feet, and growing out of swamp. Over a considerable portion of the rest of the region, the subsoil water lies close to the surface.

Swamps.

The swamps vastly extend in the rains, and are covered by rank vegetation. They partially dry in the cold season, and then large quantities of decaying organic matter is left on the drying margins of the swamps, fermenting into decomposition under the sun.

Hot, moist
atmos-
phere.

The atmosphere is uniformly humid, being nearly saturated with aqueous vapour, and the climate is hot.

Marsh
water, the
common
drinking
supply.

The inhabitants commonly live on patches of high land bordering on the marshes, and use, for all domestic purposes, the marsh water, saturated with malaria. Wells are unknown. Either water direct from the marshes, or from some small stream running through the swamps, is the ordinary supply for all purposes of the villagers not living on the large river—the Brahmaputra.

Hence
malarial
diseases
abound.

It will scarcely be a matter of wonder then, that malarial affections are almost universal, or that this

region should be one which affords special facilities for the study of affections of malarial origin.

“ It ”—malaria—“ is capable of drifting along plains to a considerable distance from its source, particularly in the direction of the prevailing winds. It ascends mountains, especially when favoured by ravines and currents of air.”

Malaria drifted by air currents.

“ It is believed that 500 feet is the limit in temperate climates, and from 1,000 to 1,500 in tropical countries ; while others assert that the latter are not safe from its influence till a height of 5,000 feet is reached. It is probable that, when men suffer from malaria at elevations above 2,000 feet, it is either derived from unsuspected local sources, or it is carried up ravines by currents of heated air from the unhealthy plains. It is a common belief in India that water is capable of absorbing malaria, and that periodic fevers, dysentery, and even cholera are produced by drinking water so charged.”

Height to which malaria may extend from the plains, in temperate, in tropical climates.

Water absorbent of malaria.

The present writer would enlarge upon this. Whatever doubts may be entertained as to the identity of the poisons of cholera and malaria—and, he thinks, that the present opinion of the profession is little in favour of that view—it will now be generally admitted that the poison or poisons of all these, and other, diseases are commonly introduced into the system in the drinking water ; many would maintain that they are principally, or almost invariably, so introduced. The great endemic home of cholera

is, moreover, in the low-lying, marshy, plains of Bengal, where all the elements of the malarial poison also abound, and where malarial affections are more or less universally prevalent.

The marked power which water possesses of absorbing malaria is, probably, in very many cases, the chief factor in the spread of affections due to the introduction of that miasm into the system.

If soil be impregnated with malaria, the water on or in the soil necessarily becomes charged with it.

When a soil abounds in the elements of malaria, and that poison is constantly being produced therein, the water lying on, or in, such a soil becomes highly charged with the miasm. In many malarious regions the ordinary domestic supply of the inhabitants is the water—necessarily saturated with malaria—derived either directly from swamps (or from wells into which surface water has access), or, indirectly so, through streams formed of the drainage of the malarious soils, and often coming from, or through, terrais, marshes, or rice lands.

This water may carry the poison even into distant regions.

Such water may remain highly charged with malaria, after flowing great distances, and may diffuse malarial affections through distant regions where it is used for drinking purposes. Thus, districts in whose soil the elements of production of malaria do not exist, and which are remote from truly malarious regions, may yet suffer extensively from affections due to malaria, owing to that poison being largely introduced into the district, and into the systems of the inhabitants, in a watersupply derived from

And regions which do not produce malaria may yet suffer from prevalence of malarial affections.

sources abounding in the elements of malaria. In many cases in which malaria has travelled from its origin to distant regions, it has been found to have followed the direction of running watercourses, and, therefore, has probably been carried in drinking water rather than borne on air currents. Many regions of the North-West Provinces and of the Punjab are notoriously scourged by malarial affections, although their soils are among the driest in the world, and are characterised by a marked absence of organic matter.

Regions scourged by malarial disorders, yet in themselves not producers of malaria. Soil exceptionally dry.

A series of exact experiments on these points, conducted by an officer of extensive special experience in those provinces, has shown that, in certain regions, during the prevalence of malarial affections, the ground had to be excavated to a depth of above thirty feet before any water was come to, and that several specimens of soil, procured by digging to a depth of six feet, were found, on analysis, to contain not more than from eleven to twelve per cent of water: ordinary soils, which would be classified as "dry," containing from thirty to thirty-five per cent of water.

Subsoil water very remote from surface.

Thus, analysis of the soil of Meanmeer taken four feet below the surface, gave only eleven per cent of moisture; and similar analysis of the soil of Rawal Pindi, taken six feet below the surface, gave only twelve per cent of moisture.

Analysis of soil at Meanmeer and Rawal-Pindi.

These analyses were conducted by the then Sanitary Commissioner of the Punjab—Dr. A. C. C. De-Renzy, and malarial fevers were extensively prevalent

in these regions at the time of the analysis of their soils.

Absence of organic matter. All elements of production of malaria absent from the soil, yet malarial diseases abound.

Moreover, the soils of certain of these same regions were so barren of organic matter that it was notorious that no crops could be got out of them unless they were first manured, and they bore no kind of natural vegetation, were in fact sterile, arid, and desiccated. Why then were malarial affections so prevalent in these regions?

Reason. Malaria introduced to the region in the water-supply. Malaria carried by water currents into regions of non-production of malaria. Streams are often composed of the drainage of terrais and swamps.

It seems certain that the miasm must have been introduced from without. In many cases the nearest region of production of malaria,—*viz.*, terrais and marshy regions,—were not in the directions of the prevailing winds, and it can scarcely be contended that malaria is capable of remote diffusion, through the air, in a direction contrary to the prevailing currents of wind. The probable explanation is, that the streams and nuddes, which constitute, with wells, the chief water supply of these parched regions, are formed by the water which has drained from the forests and jungle of low mountain ranges, and from the terrais and marshes

And are, at their origin, saturated with malarial poison.

at their bases. This water, owing to its absorbent power, starts for the plains saturated with the malaria existing in the miasmatic hot-beds in which the stream has collected, and it, doubtless, remains for a long period highly charged with the poison. Such water, when introduced into the system, by drinking, carries with it the miasmatic poison, and causes malarial diseases just as certainly as water charged with choleraic dejecta, or with the virus of smallpox

would, when introduced into the system by drinking, cause those diseases respectively.

In the Punjab, where well water is commonly one of the chief sources of supply for drinking purposes, analyses have shown that, in numerous instances, all the elements for the generation of malaria have been present, in startling proportions, in the wells themselves.

Local sources of malaria in wells.

Extensive sediments of organic matter often decomposing, sometimes offensive, have been found at the bottom of these wells ; and, on the occurrence of sudden rises in temperature, the waters of these wells have been found discolored, and pervaded by organic particles in a state of active decomposition.

Organic matter in active decomposition.

In such cases as these, it is not necessary to presuppose any primary generation of the miasm to have taken place in the soil ; for such wells themselves form natural laboratories for the production of the miasm.

Malaria produced by these local elements.

It will be seen, therefore, how readily a region may acquire and maintain a well deserved reputation for being malarious, by means of miasm introduced into the district in the running currents of drinking water, or by the local production of the miasm in the wells or reservoirs for storage of the drinking supplies.

Many of these foci of prevalence of malarial affections in the drier regions of India—the Punjab, and North-West Provinces—should be absolutely free from malarial contamination, if the miasm could be developed only in a moist soil containing organic matter,

Regions whose soil and air is non-malarious.

and could only be introduced into the system through the agency of its diffusion through the air respired.

Soil free
from organic
matter
and dry.

As has been previously pointed out, in many malarious regions of India, the soil is notoriously free from organic matter, and this freedom has been verified by careful and skilled analyses ; it is exceptionally dry,

Water only
found at
great
depths.

water being only met with at great distances from the surface, sometimes from 60 to 100 feet, while the soil for some feet below the surface is practically desiccated.

Can malaria be generated in such a soil?

From what source is malaria diffused through the air of such a region?

Yet many such regions are, undoubtedly, a prey to diseases of malarial origin.

Probably
neither soil
nor air at
fault.

It seems gratuitous to assume that, in such cases, the soil and the air are at fault. Probably, the poison neither is generated in the one, nor is present in the other.

Look for
other
sources of
malaria.

We must then look for other sources of production, and for other media of introduction of the poison into the system.

Water-
supply
contains
miasm.

When such a region is afflicted with malarial complaints, the elements of production of the miasm can, almost always, be clearly traced to the watersupply, either at the distant sources from which a running stream is derived, perhaps swamp, or terrai; or in the local places of storage, the wells, or reservoirs.

These regions cannot be defined as malarious in the ordinary acceptation of this term.

Far otherwise was the condition of the soil in such Walcheren, a region as Walcheren, at the time of the unfortunate expedition.

Here, although the surface was a barren, arid plain, devoid of vegetation, yet the sandy soil was found to be laden with organic matter, and the subsoil water lay everywhere close to (within a few feet of) the surface, being kept up by beds of stiff, impermeable, clay, which formed the strata beneath the sand.

Dry on surface, subsoil water close to surface, and much organic matter in the sandy soil.

Such a soil is, on the face of it, typically malarious; the miasm is extensively generated locally, and must pervade the air and saturate the water.

Typically malarious.

In one of the most typically malarious districts in India—Lower Assam—the conditions are in every way different, and a marked contrast to those obtaining in the dry malarious regions of the North-Western Provinces and the Punjab. Here, the elements of malaria everywhere exist locally, and in a most strikingly palpable form, on the surface, and quite in the form ordinarily described in text-books.

In Lower Assam,

all the elements of malaria palpable on surface.

Extensive permanent marshes form a large portion of the surface of the land; the soil is an alluvium, rich in organic matter; beds of stiff clay, close below the surface, keep the water up, on, or near, this surface; rank luxuriant vegetation, in the form of vast jungle, annually springs up and dies down into decomposition in the swamps. The marsh water is thus laden with vegetable organic matter. When, to these conditions, are added a high temperature and a

Permanent marshes. Alluvial soil rich in organic matter. Water on or close to surface. Vast jungles.

moist atmosphere, it will be granted that the elements of production of malaria are abundantly present in no disguised form.

Air over such regions charged with malaria.

There is little doubt that the air of these regions may be largely impregnated with malaria, and that the poison may be introduced into the system by respiring such air.

The water of such marshes charged with malaria.

On the other hand, it will scarcely be denied that the water of such marshes is, itself, surcharged with the malarial poison, and as, directly, or indirectly, the water, so charged, forms the main drinking supply of the inhabitants, it seems certain that the miasmatic poison must be largely introduced into the system in this drinking water.

The poison concentrated, and in larger quantities introduced by water.

As water is capable of holding in suspension and solution such large quantities of matter, it is presumable that malaria is introduced into the system in a much more concentrated condition, and in much larger quantities at one time, when the agency of introduction is the water drunk, than when the agency is to the air respired.

The malaria active and rapid in action when taken into stomach.

It is probable that, as is the case with other poisons, such as the choleraic, the malarial poison is more quickly assimilated, and acts more rapidly and energetically, when taken into the stomach, than when introduced into the lungs.

Protection by use of pure water.

There is a considerable amount of evidence to show that, even in the most malarious regions, those who boil and filter their water, or who take care to

use a supply untainted by malaria, rarely suffer from the more severe forms of malarial fever, and enjoy considerable immunity from even the slighter forms.

Extended experience is showing, in a remarkable way, the prominent part played by drinking water as a vehicle of spread of malarial affections—as of those of other origin.

Prominent part played by drinking water in the spread of malarial disorders.

The writer's personal and professional experience, during seven years, in one of the most intense malaria-producing regions in India, has convinced him of the marked immunity from malarial affections enjoyed by persons who, though living continuously in this typically malarious region, yet carefully avoid introducing the miasm into their systems in their drinking water. Among the ordinary populations, who habitually drink raw water, directly or indirectly of marsh origin, malarial affections of one kind or other may be said to be almost universal.

Protection from malarial fevers afforded by the use of pure water.

Among the Europeans and enlightened natives, who have of late years paid more attention to their supply of drinking water, malarial affections have markedly decreased in frequency and severity.

Those who habitually avoid the use of water directly or indirectly of swamp origin, and who take care to destroy the germs of malaria (by boiling and filtering their water, or making it into tea) enjoy, even in these intensely moist, malarial regions, bounding in jungle and marsh, an immunity from diseases of malarial origin nearly equal to that

Protection afforded by use of water whose malarial germs have been destroyed.

enjoyed by residents of non-malarious tropical climates.

Without venturing to assert that the malarial poison is not commonly introduced into the system through an atmosphere containing it, the writer's experience is that marked immunity from its effects may be enjoyed, even in intensely malarial regions, when the poison is systematically prevented from entering the system in the drinking water.

Malaria
intense in
action
when
introduced
by water.

There is strong evidence that the malarial poison exerts its effects in a much more intense and rapid form when introduced into the system in drinking water than when introduced in the air respired.

Case of the
"Argo."

The case of the "Argo," as recorded by Boudin, and quoted by Parkes (*Hygiene*, p. 71), seems to afford conclusive proof of the introduction of the malarial poison into the system in drinking water, and of the intensity and activity of poison so introduced. In this instance the evidence on the point seems most complete and exhaustive.

Malarial
fever
caused by
use of
swamp
water for
drinking.

The case is thus detailed by Parkes :—

Case of the
"Argo."

"In 1834, eight hundred soldiers, in good health, embarked in three vessels to pass from Bona in Algiers to Marseilles. They all arrived at Marseilles the same day. In two vessels there were six hundred and eighty men without a single sick man. In the third vessel, the 'Argo,' there had been one hundred and twenty men; thirteen died during the short passage (time not given), and of the one hundred and

“seven survivors, no less than ninety-eight were dis-
“embarked with all forms of paludal fevers, and, as
“Boudin himself saw the cases, there was no doubt
“of the diagnosis. The crew of the ‘Argo’ had not a
“sick man.

“All the soldiers had been exposed to the same
“influences of atmosphere before embarkation. The
“crew and the soldiers of the ‘Argo’ were exposed to
“the same atmospheric condition during the voyage ;
“the influence of air seems, therefore, excluded.
“There is no notice of the food, but the production
“of malarious fever from food has never been sug-
“gested. The water was, however, different ; in the
“two healthy ships the water was good. The sol-
“diers on board the ‘Argo’ had been supplied with
“water from a marsh, which had a disagreeable taste
“and odour ; the crew of the ‘Argo’ had pure
“water.

“The evidence seems here nearly as complete as
“could be wished.

“One very important circumstance is the rapidity
“of development of the malarious disease, and its
“fatality when introduced in water. It is the same
“thing as in the case of diarrhœa and dysentery.
“Either the fever-making cause must be in larger
“quantity in the water, or, what is equally probable,
“must be more readily taken up into the circulation
“and carried to the spleen than when the cause
“enters by the lungs.”

The following instance has occurred in the writer's own experience :—

Case of
Nungpho.

The journey from the plains to the hill station of Assam commences at Gauhati (180 feet above the sea level), and terminates at the station of Shillong, in the Khasia hills, (4,600 feet high). This journey of sixty-four miles is usually broken by a halt, for one night, at the midway dâk-bungalow of Nungpho (1,300 feet high). So frequently was an attack of fever acquired during this single night's halt, that such an attack used to be looked on as a necessary, and almost unavoidable, accompaniment of the journey. Quinine was invariably taken on the journey, as an essential prophylactic, and the approved and generally adopted custom was, that the traveller should, at sunset, shut himself almost hermetically in his bedroom, beneath the mosquito-curtains, and, if possible, beneath the bed-clothes.

Nungpho.

It was held that the miasm was carried up the ravine by currents of air from the malarial plains, and concentrated in the narrow valley in which Nungpho is situated. Practically, however, the currents of cool air are found to set down these elevated valleys to the plains below, to supply the rarified currents of heated air which ascend from the hot plains to the higher regions of the atmosphere.

Example of
malaria
being intro-
duced into

The malaria at Nungpho is now admitted to be of local origin, and its mode of introduction into the

system is tolerably well ascertained to be through the watersupply. The only water procurable at Nungpho is that of extensive swampy tracts, or of small streams entirely derived from the drainage of contiguous terrais, swamps, and paddy-lands, in which are concentrated all the elements of malaria. So clearly is this now understood that the traveller of the present day absolutely avoids all use of the local water at that station, and, usually, travels furnished with supplies of pure liquids, or drinks no water on the journey. It is now common to find the traveller at Nungpho armed with a bottle of pure water, or tea, brought with him; and even more faith is put in this than in the prophylactic use of quinine. It is certain that, now, attacks of fever rarely result from this journey; and Nungpho has almost died out of memory as a fever-producing region so far as Europeans are concerned. Natives, however, suffer almost as frequently as formerly; and a night at that station is still dreaded by them as a certain harbinger of an attack of ague. The reason, no doubt, is, that they use the most convenient, and indeed the only, water accessible, *viz.*, the drainage of the terrais saturated with malaria.

the system by use of terrai drainage as drinking water; and of disuse of such water leading to cessation of malarial fevers.

On this point, too, it will well reward the enquirer to compare the statistics of several towns in the Punjab and North-West, and of Hong-Kong, before the introduction of a more or less pure watersupply, and the similar statistics of the prevalence of com-

Statistics of diminished prevalence of malaria following improved watersupply.

plaints of malarial origin, since the watersupply has been looked to and remodelled.

Malaria
introduced
by water.

There is abundant evidence to show that one common mode of introduction of the malarial poison into the system is by means of using, for drinking purposes, water charged with that miasm.

Antiquity
of belief.

The belief that malarial affections may be caused by drinking water charged with the paludal miasm, has prevailed from the most ancient times. Hippocrates ascribes the production of enlarged spleens to the use of marsh water for drinking purposes. Rhazes re-asserts this, and affirms that it also generates fevers.—*Parkes*.

Prevalence
of the
belief.
Plains of
Troy.

Parkes further notes that this belief is universal among the inhabitants of the highly malarious plains of Troy.

India.

“The same belief is prevalent in the South of India, and in Western Candeish, Canara, Balaghut, and Mysore, and in the deadly Wynaad district.”—*Ibid*.

Evidence
on the
point:
In India.

Mr. Bettington, of the Madras Civil Service, notes (Indian Annals, 1856, p. 526) that, in one village, there were two sources of supply,—a tank fed by surface and marsh water, and a spring; those, only, who drank the tank water, suffered from fever.—*Ibid*. “In another village (Tullivaree), no one used to escape the fever; Mr. Bettington dug a well, the fever disappeared, and, in the last fourteen years, has not returned.”—(*Parkes’ Hygiene*, p. 71.)

A further instance is referred to, in which, in the parish of Houghton, almost the only family which escaped ague, was that of a farmer, who used well water, for drinking purposes, instead of the ditch water used by the other inhabitants.—(Parkes' Hygiene, p. 71.)

In a Report, by Dr. G. Whitley, as to quantity of ague now prevailing in England (Sixth Report, Privy Council, 1863, p. 441), it is recorded that, at Holbeach and Long Sutton, ague and enteric fever were both prevalent. "The drainage of these places is bad, and their watersupply bad, being from pits."

Professor John Harley observes that:—"Impure water appears to be equally a cause of intermittent fever and its complications. The Inspector of Hospitals writes of Walcheren, during the prevalence of the severe intermittent fever there:—"The bottom of every canal, that has communication with the sea, is thickly covered with an ooze, which, when the tide is out, emits most offensive and noisome effluvia; every ditch is filled with water, which is loaded with animal and vegetable substances, in a state of putrefaction; and the whole island is so flat, and so near the level of the sea, that a large proportion of it is little better than a swamp; there is scarcely a place where water, of a tolerably good quality, can be procured." Sir John Pringle mentions 'that the men-of-war, which lay all the time at anchor in the channel, between South Beveland and Walcheren, even during the worst period of the

Report to
Privy
Council.

Evidence
at Wal-
cheren.

“ ‘distemper, were not afflicted with either flux or
 “ ‘fever, but enjoyed the most perfect health.’—(Davis
 “ on the Walcheren Fever, 1810, p. 15). These
 “ sailors were doubtless supplied with a supply of
 “ good water.

“ The inhabitants of a marsh, seated in a basin of
 “ clay, or level with the bed of a river, must of
 “ necessity drink water contaminated with their ex-
 “ cretions and other impure matters, if the water be
 “ derived from the marsh itself, and the drier the
 “ season the more concentrated the poisonous im-
 “ purity.”—(Reynolds’ System of Medicine, Vol. I,
 p. 410, *et seq.*)

Evidence on this point, *viz.*, the causation of
 malarial fevers, and their complications, by the use
 of impure water containing decomposing vegetable
 matters, could be multiplied indefinitely.

Protection
 afforded by
 an inter-
 vening
 expanse of
 water or
 sea.

“ The absorbing power of water, and especially of
 “ salt water, has often a beneficial effect when a suffi-
 “ cient breadth of it, not less than three quarters
 “ of a mile to a mile, is interposed between our ha-
 “ bitations and the source of the poison, which is
 “ either absorbed or rendered innocuous in transit.”

This protection may, to some extent, arise from
 mere dilution of the poison during its transit through
 the air, and to destruction of its elements by the
 iodine present in an atmosphere over sea-water.

Protection
 by belts of
 trees.

“ Belts of trees interposed, in like manner, ex-
 “ ercise a protective influence.”

“ Malaria disappears before cultivation and sub-
“ soil drainage with free exposure of the soil to the
“ action of air and of living vegetation. When,
“ however, the hand of man is withdrawn, and the
“ old conditions reappear, malaria again resumes its
“ sway.”

Malaria
disappears
before cul-
tivation
and drain-
age.

“ It is the cause of intermittent and remittent
“ fevers and their sequels ; it ‘underlies’ the cause of
“ dysentery and cholera ; and, by its depraving in-
“ fluence on the constitution, it often silently under-
“ mines the health without the manifestation of any
“ febrile phenomena. When a person has for some
“ time suffered from the toxic influence of miasm, a
“ curious impress of periodicity is sure to show itself
“ in all his subsequent ailments, whatever be their
“ nature, and, I believe, from extensive observation,
“ that this impress of periodicity is never eradicated.”

Diseases
caused by
malaria :
intermit-
tents,
remittents.
Relation to
dysentery,
cholera.

In Chapter V, is discussed the scope and meaning
of the term “ periodicity ” as applied, and specially
referrible, to malarial affections.

To the above-mentioned diseases, caused by mala-
ria, may be added diarrhœa, in the production of
which malaria probably acts as a direct cause, and,
by the constitutional cachexia and visceral enlarge-
ments it induces, as an indirect cause, in other cases.

Diarrhœa.

Moreover, it has been previously remarked that
malaria often complicates typhoid, forming a distinct
type of fever classed as the typho-malarial, or palu-
dal-enteric ; it has been noted to what an extent this

Malaria
with
typhoid.

Malaria in
relation to
dysentery.

Evidence.

Periodic
fever.

Action of
quinine.

Dysentery
in England

type of fever prevailed at Walcheren ; it caused great ravages in the army of the Potomac, and still prevails in certain low-lying regions, in and about London, where agues were formerly so rife. With regard to the influence of malaria in producing dysentery, Professor Maclean says :—“ Malarious dysentery—by this “ term I mean to indicate those cases in which malaria “ acts with a high degree of intensity on the system, “ developing in addition to the symptoms already “ described, those which are characteristic of malarial “ fevers—such cases will be recognised by the periodi- “ city of the febrile paroxysms, the presence of gastric “ irritability, such as we see in remittent fevers. “ There is also a therapeutic aid to diagnosis ; ipeca- “ cuanha is not well borne, and quinine acts power- “ fully in checking the febrile paroxysms.”—(Reynolds’ System of Medicine, Vol. I, p. 630.)

“ For my own part, I believe dysentery to be caus- “ ed by the action, on the blood, of a poison——. “ This poison I believe to be a malaria generated in “ the soil by the decomposition of organic matter. “ Once a common and fatal disease in this country ”— “ England—“ it is now so rare that a London physi- “ cian rarely, if ever, sees a case of genuine specific “ dysentery, save such as have been imported from “ malarious countries. How comes it that a disease “ with which our predecessors were so familiar has “ become so rare ? Many of the commonly received “ ‘ causes ’ are as much in operation now as then ; *e.g.*,

“the combined action of cold and moisture, the ac-
 “tion of irritants on the mucous membrane, unripe
 “fruit, unwholesome and indigestible food of all
 “kinds, fœculent and other accumulations in the
 “larger intestines, yet dysentery does not result. Is
 “it not that, for the reasons already assigned, less disappear-
 “malaria is evolved from the soil? It seems that just ed with
 “in proportion as we have banished malaria, so have malaria.
 “we got rid of dysentery.”

He goes on to instance the prevalence of dysentery in Dysentery
 the Millbank prison, and adds, that Dr. Baly was led to at Millbank
 the conclusion that it was “due to a poison introduced and at
 “from without, *viz.*, a malaria rising from the soil.” Secundera-
bad.

He further remarks, that “in India dysentery pre-
 “vails most, and is most fatal in moist alluvial soils
 “containing organic matter in a state of decomposi-
 “tion”—though admitting that the disease prevails,
 also, in a most severe form, in places which are not
 alluvial, as in the old infantry barracks at Secundera-
 bad, and adds—“but there, as at Millbank, the con-
 “ditions necessary for the production of malaria were
 “only too abundant—the surface and subsoil are
 “thoroughly saturated with organic matter.”—(Rey-
 nolds’ System of Medicine, Vol. I, p. 624, *et seq.*)
 This organic matter seems to have been of vegetable
 as well as animal origin.

The influence of malaria in the causation of diarr- Diarrhœa
 hœa is commented on by Professor Edward Goodeve. caused by
 He remarks with regard to the causes producing malaria di-
rectly and
indirectly.

diarrhœas :—"Those due to constitutional derangements may be secondary to such diseases as chronic malarious complaints, with enlargements of liver and spleen."

"He further notes :—"Diarrhœa often prevails in malarious countries without preceding obvious cachexia, and its mode of production in them affords matter for discussion. It is doubtful whether it arises directly from the action of malaria, or whether this acts merely as a predisposing cause, by which the system becomes readily susceptible to the external impressions causative of diarrhœa. The high

Morehead's
opinion.

authority of Morehead is in favour of the view which restricts malaria to a predisposing cause only ; but, with due deference to his opinion, the writer finds it hardly possible to escape the conclusion that

Goodeve's
opinion.

"in a certain number of cases, the flux may come on in an early stage of contamination of the system, before recognisable cachectic influences appear, and where external impressions are not traceable."

Malarial
chronic
diarrhœa.

In treating of chronic diarrhœa, white flux, or cachectic diarrhœa, he notes—"It is often met with in persons who have in some way suffered from malaria It is probably due to direct or indirect action of malaria acting feebly and slowly on the system. It is not improbable that there may be more than one form of chronic constitutional diarrhœa in India and elsewhere, but, in the majority of cases, it will be found that they

“are secondary to scurvy, recognizable malarious disease, &c.”—(Reynolds’ System of Medicine, Vol. I, pp. 646—654, *et seq.*)

He further notes :—“It would be well to use Use of quinine in :— quinine in all cases in which malaria may be supposed to be operative”—a valuable therapeutic test.

Finally he recommends that—“Diarrhœal patients should remove from low and damp situations, and from dwellings subjecting them to malarious or vitiated atmospheres, to places in dry and open situations.”—*Ibid*, p. 664.

With regard to the statement that malaria “under-Cholera in relation to malaria. lies the cause of cholera,” there does not seem any evidence of the identity of the poisons of malaria, and of cholera. It is, however, certain that the conditions favourable to the production of the malarial miasm, are also favourable to the development of poison of cholera.

As pointed out by Dr. Chas. Macnamara (Macnamara’s and Goodeve’s opinions. Treatise on Asiatic Cholera, 1870) and by Professor E. Goodeve (Reynolds’ System of Medicine, Vol. I.) this is probably because these low-lying situations—favourable alike to the development of malaria and of cholera—combine many unfavourable sanitary conditions, moist subsoil, bad drainage, defective ventilation and air movement, impure air, and dense population.

The endemic home of cholera is in regions in the Malaria and cholera in India low-lying alluvial plains of Bengal; and, in temperate climates, the disease has had most rapid and

fatal spread in seaport towns situated on alluvial low grounds, on the banks, or at the mouths, of rivers or estuaries.

And in
England.

In London and its neighbourhood, the mortality from cholera was more than ten times heavier in the lowest-lying districts about the level of the Thames, than it was in the higher regions.

It has previously been remarked that Professor J. Harley describes these low-lying regions as still furnishing numerous cases of paludal-enteric fever—a mixed type of malarial intermittent and typhoid—and that these same districts were formerly the favourite home of ague.

It will be seen how wide and varied an influence malaria has in the production or complication of disease.

CHAPTER II.

ACTION OF MALARIA.

Malarial Lesions of Stomach and Liver.

The action of malaria on the system is to cause dilatation of the vessels—congestion—of all the upper digestive organs—notably the spleen, stomach, liver, and duodenum—with or without fever of an intermittent or remittent type. This congestion of the viscera is shown by the symptoms during an attack of malarial fever :—gastric tenderness and irritability of the stomach being always present ; indeed, gastric disturbance and vomiting are often the most obstinate and distressing symptoms.

Action of malaria on the system.

On stomach, spleen, liver.

The congestion of the spleen causes enlargement of that viscus, the occurrence of which during, and subsidence on the termination of, an attack are capable of easy demonstration by tactile examination. These symptoms may disappear on the subsidence of the febrile attack.

From repeated attacks of such fever, or from prolonged malarial poisoning without febrile disturbance, this condition of congestion of the viscera may become confirmed, and chronic structural changes result.

Chronic structural changes take in each viscus special forms.

These changes, in the case of each viscus, take a special form depending on its structure and consequent mode of alteration from chronic congestion.

We shall consider each of the viscera separately.

Temporary lesions.

Hyperœmia and congestion of mucous membrane.

A—Stomach:—action of malaria on, chronic and temporary. During each attack of malarial fever, there occurs great hyperœmia of the viscus, especially of its mucous membrane; the arteries dilate, and the vessels generally are gorged with blood. This state of vascular turgescence subsides with the ending of febrile paroxysm, and the viscus returns to its normal condition of vascularity.

From repetitions of febrile attacks, or from chronic malarial poisoning, these changes may progress into chronic lesions.

This state of hyperœmia of the stomach during a paroxysm of malarial fever, is shown by the pain, sense of distention, and tenderness on pressure, over the gastric region, and by the irritability of the stomach, which almost invariably accompany an attack of malarial fever. Obstinate and persistent vomiting is often a most distressing symptom.

Diagnosis of typhoid from remittent.

In the diagnosis of typhoid from remittent fever in India, these abdominal symptoms are often of the highest value. In typhoid the tenderness is usually over the right iliac region, pain and gurgling being caused by pressure there, while there is usually little irritability of the stomach, and little or no pain on pressure over epigastrium. The explanation is,

that, in remittent fever, the gastric symptoms are most prominent, as the stomach especially suffers; while, in typhoid, the ileum, and colon in the region of the ileo-cæcal valve, especially suffer.

In these two types of fevers, the pyrexia frequently differs so little, that, often, in India, no conclusion of diagnostic value can be drawn from that symptom. In the dark-skinned races of India, the spotted rash of typhoid can rarely be distinguished, and, even in lighter colored skins, the heat-rashes, so common in India, may obscure the few rose-colored spots of the typhoid rash. So that the evidence afforded by the seat of the tenderness, or pain, in the abdomen, is often of the highest diagnostic value in differentiating these two fevers from each other in India.

(b) *The permanent* structural changes in the stomach, due to chronic malarial poisoning, take the form of venous congestion and purple discoloration of the mucous membrane; the sub-mucous coats may be thickened and more or less gelatinous, in very chronic cases; these appearances most markedly resemble those found in the rectum in old standing chronic dysentery, *viz.*, the violet, or purple, discoloration of the mucous membrane and the gelatiniform-thickening of the sub-mucous coat.

Chronic lesions, resembling to dysenteric lesions.

The writer has never, himself, found ulcers on the mucous membrane of the malarious stomach, but their presence has been noted in certain cases. Thus, in some of the cases examined after death at Wal-

Malarial ulcers on the mucous membrane of stomach at Walcheren.

cheren, during the terrible epidemic of malarial fevers, which our troops suffered from, in that unfortunate expedition, Sir Gilbert Blane found circular ulcers in the mucous membrane of the stomach, as well as hyperæmia—(Maclean, Reynolds' System of Medicine, Vol. I, p. 600.)

The lesions of the stomach, in such cases, would be practically identical with those of the rectum and lower colon in dysentery.

Almost
identity of
lesions.

It is interesting to note this more or less complete identity of the lesions of a malarially poisoned stomach and a dysenteric rectum.

Perhaps this identity of lesions may be taken as a further proof of the identity of the poisons.

The writer does not remember to have seen attention called to this more or less complete identity of these lesions by any writer on malarial affections; but it has frequently struck him forcibly in the frequent post-mortem examinations made, in this district, of the bodies of persons who have suffered from dysentery, and from chronic malarial poisoning.

Duodenum,
lesions of.

The duodenum suffers much in the same way, and to the same degree, as the stomach.

Dyspeptic
diarrhœa
from irrita-
tion of py-
lorus and
duodenum.

The obstinate dyspeptic diarrhœa, white flux, cachectic diarrhœa, of Goodeve—so frequently a most persistent symptom in chronic malarial poisoning—may be regarded as resulting largely from the irritable condition of the pylorus, and consequent inability of the stomach to retain the food sufficiently

long for it to undergo complete gastric digestion ; while, at the same time, the irritable duodenum hurries this partially digested food on to the lower bowels.

In all malarial affections the gastric irritability is one of the most marked symptoms, varying from the intense epigastric tenderness, with obstinate and distressing vomiting, of severe fever, to the chronic dyspepsia and sub-acute gastritis of the malarial cachexia.

Gastric irritability in all malarial affections.

In the intensely malarial region in which the writer's practice has lain during the last seven years, he has found that a low form of sub-acute gastritis is one of the most common affections which he has been called on to treat.

Malarial chronic gastritis.

This is extremely common, even in persons who do not suffer from distinct malarial fevers.

Another most prevalent complaint, which the writer has had, almost daily, to treat, is the dyspeptic diarrhœa above noticed. The dejecta, in such cases, practically consist of the partially digested, recently ingested, food, in just the condition in which a meal is found in the stomach about the middle of digestion, but bile-tinged. The stomach, pylorus, and upper intestine are evidently in fault—have indeed been unable to retain the food a sufficient time to ensure complete gastric digestion.

Dyspeptic diarrhœa. Dejecta partially digested bile-tinged food.

This complaint has, in the writer's practice, been almost entirely restricted to persons whose constitutions have been saturated with the malarial poison,

from long residence in these regions, and who, commonly, have ceased to suffer from distinct periodic fevers, though, ordinarily experiencing periodical faint febrile flushes.

In the cases of malarial dyspepsia, to which present reference is made, the writer's knowledge of the habits and mode of life of the sufferers has enabled him to dismiss, as untenable, the theory that excesses in diet, or in the use of stimulants, has, in any way, been a factor in the production of the train of symptoms alluded to.

Dyspeptic
diarrhœa.

Doubtless, similar dyspepsia, and pale diarrhœa of imperfect digestion, may result from irritability of the gastro-intestinal mucous membrane, and defective biliary secretion, due to structural changes which have arisen from the use of alcoholic liquids in excessive quantities or in too concentrated a form, and from habits of indulgence in a dietary scale too liberal in amount and too stimulating in quality.

Gastric
irritability
from dietetic
excesses.

Other
Dyspepsias
wholly
malarial.

However, some of the worst cases of dyspepsia and gastric irritability, which the writer has seen, have been in persons of strictly temperate habits, both as to eating and drinking ; while, in many cases among natives, the sufferer has never known, in any form, the taste of alcohol (forbidden alike by his religious tenets and his poverty), and has, in his dietetic desires, had no ambition beyond the addition of a few ounces to his daily gorge of rice—his staple article of food

The writer has met with more than one case in which severe dyspepsia and gastric irritability—undoubtedly the sole result of too constant and prolonged a residence in intensely malarious regions—has, on superficial examination, been ascribed to habits euphemistically described by the term “free living,” *i. e.*, excessive indulgence in stimulating food and alcoholic liquids.

Among medical men, and others, whose experiences of the capability for mischief of prolonged exposure to malarial influences have, happily for themselves, been circumscribed, owing to their lot having been cast in healthier regions, there is too often a tendency to jump to the conclusion that this train of gastric symptoms bears, on the face of it, evidence presumptive that excesses in drinking, or in eating, or in both, are concerned as a cause in producing it; and on this assumption, uncomfortable suspicions may be started as to the temperance of habits of a patient, in this respect irreproachable—who may, in fact, be wholly and solely a victim to malaria.

This chronic dyspepsia, and irritability of the stomach and duodenum, are the most prominent and universal symptoms among persons suffering from malarial poisoning in this region of Assam; they are frequently present, also, in persons who, though living in miasmatic regions, are not yet marked by the apparent signs of malarial cachexia.

Necessity
of care in
diagnosis.

Malaria a
sufficient
cause of
worst
forms of
Dyspepsia.

Chronic
gastritis
and dys-
pepsia—
earliest
symptoms
in mala-
rial
cachexia.

Relieved by
quinine, or
sedatives.

All these symptoms—the gastritis, dyspepsia, and dyspeptic diarrhœa—are relieved by sedatives, opiates, and especially by quinine.

It is this distressing irritability of stomach which renders treatment so difficult in certain cases when not even a drop of water can be retained.

As gastritis
and dyspep-
sia disap-
pear, spleen
becomes
permanent-
ly enlarged.

This irritability of stomach and dyspepsia are usually the first symptoms complained of at the early period of slow malarial poisoning; and as they appear, the spleen will be found descending below the ribs into the lower abdomen.

Malarial
and non-
malarial
gastritis
contrasted
in their
symptoms.

This malarial sub-acute gastritis differs from the more common non-malarial chronic gastritis in the fact that in the former disease the patient feels fairly well while the stomach is empty, he has no desire for food, and, immediately on its ingestion, his troubles commence; it is either rejected by vomiting, or, with pain and oppression, digestion goes on, and, when partially performed, the matters are hurried off, and out of the system, by diarrhœa, and the patient is relieved again. In ordinary, non-malarious, chronic gastritis, the patient usually experiences great relief from ingestion of food, has little uneasiness while the stomach is full, or contains food, but suffers from such a constant gnawing sensation in the stomach, when that viscus is empty, that he is constantly nibbling at a biscuit or other practicable light food.

The writer could quote a long list of cases of malarial poisoning similar to the type above referred to.

Similar irritative dyspepsia may arise from other than malarial causes.

All these symptoms doubtless arise from the congestive changes above referred to as existing in the malarial stomach. Rationale
of above
symptoms.

Opiates often afford great relief to this state of gastric irritability, and, by lessening this symptom, cause the stomach and intestines to retain the food sufficiently long for perfect and complete digestion to take place.

Minute doses of opium or morphia—far below the amount capable of causing any narcotic symptom—will afford marked relief to the dyspeptic symptoms, and marked improvement in the digestive functions and the nourishment of the body. Malarial
gastritis
and dys-
pepsia.

Marked re-
lief from
opium.

This brings us to an interesting discussion, though only a side issue of the present papers, and not in their true *scope*.

It has been noticed by other surgeons, and the writer has made it a special topic of discussion in one of his annual medical reports to Government, how marked an influence the habit of opium-eating has in conferring a resisting power against the malarial miasm. Opium-eat-
ing protect-
ing from
malaria.

The opium-eater enjoys considerable immunity from malarial affections, in the early stage—the first few years of indulgence in the habit, before the organic visceral changes are set up, and the general shattering of constitution results, which prematurely

break down the consumer of opium, and render him an easy prey to diseases of every kind.

Opium-eating chiefly a habit in malarial plains.

It is interesting to notice that the habit of opium-eating prevails almost exclusively among the inhabitants of plains-regions, and swampy malarial countries. It is rare to find any hill-races addicted to this habit.

Opium-eating in Assam.

In the plains of Assam, this habit is almost universal. In this district, the writer has made a series of exact observations on the prevalence of this habit among the large circulating population of the jail. He finds that nearly four-fifths of the men of the plains, who enter jail, are more or less addicted to this habit, consuming from 5 grains to 3 drams of the drug daily. On the other hand, he has never yet, in seven years, met with a hill-man who was an opium-eater. They are usually spirit-drinkers. The prevalence of this habit is the curse of our jail populations in Lower Assam. No work can be got out of the long-confirmed opium-eater. He can digest nothing but light food—milk or soups. On ordinary diet he suffers from diarrhœa, tending to rapidly run to dysentery. His system has very slight heat-making power, he is extremely susceptible to any changes of temperature, and cannot stand cold ; he is thus especially liable to both chest and bowel disorders.

Peculiar liabilities to disease of the long confirmed opium-eater.

Again and again he may be nursed, by a system of milk diet, gradually on to ordinary food ; again

and again he recurs to hospital, suffering from diarrhœa, dysentery, or dyspepsia.

The emaciation of the opium-eater is characteristic and extreme. Eventually, after having been a source of infinite care, after repeated courses of medical and dietary treatment, after having caused large expenditure in sick diet, extras, &c, he perishes, usually of a chest or bowel disorder, or, perhaps, from practical starvation from eventual inability to digest any kind of food, even the lightest and most delicate. On post-mortem examination, all the viscera are usually found wasted and anæmic, except the liver, which is commonly large, pale, and very fatty.

Emaciation
and last
days of the
opium-
eater.

Post-mor-
tem appear-
ances.

It has been noted how prevalent this habit is in the malarious plains of Assam. It prevails extensively in the plains of Bengal, of Behar, and of the North-West Provinces. None of the hill-tribes on the Eastern frontier are opium-eaters; and, the writer thinks, the same may be said of those on the North-Western Frontier.

Geograph-
ical limit
of opium-
eating.

In the China, too, the home of opium-eating, the same holds good, *viz.*,—that the habit prevails most extensively among the inhabitants of the low-lying malarial plains.

In analysing the formation of the prevailing habits of races, we frequently find that the accumulated experience of generations has developed the habit from some observed favourable adaptation of its conditions to the surroundings and necessities of the peo-

Rationale
of the
spread of
the habit
of opium-
eating.

ple; and such popular experience often coincides with the results of scientific research.

Granting the fact that nearly every race of mankind takes a stimulo-narcotic of some kind, we find that in temperate climates generally, and among the hill-races of tropical ones, this is taken in the shape of alcoholic liquor, in some of its numerous forms; while, in the hot tropical plains,—the favourite home of malaria,—this stimulo-narcotic is taken in the form of opium—the tenets of religious faiths often forbidding the use of alcoholic liquors.

Of the two, there is little doubt that alcohol, being the less narcotic, is better adapted to the necessarily active habits of the inhabitants of temperate climates or hill ranges; while the other—opium—being less a stimulant and more markedly narcotic than alcohol, and in some measure an anti-periodic against malaria, has acquired, and maintains, its empire among the inactive inhabitants of hot plains, where poppy-cultivation mostly flourishes.

Thus, in all probability the practice of opium-eating owed, if not its origin, at least its extended limits of spread, to the fact that the inhabitants of these low malarious plains practically found that it assisted them in resisting malarial poisons and affections.

It will be noted that in many regions where the poppy is not largely cultivated, the habit of opium-eating yet prevails extensively, and the drug has to be imported to meet the necessities of the people. In

these regions, such as Assam, for example, the habit cannot be said to be of indigenous origin ; the habit has been introduced from without : it has, however, acquired such extensive and vigorous root among the inhabitants, as could only have resulted from its having been practically found to meet some need in the life and surroundings of the people.

The hill-tribes, bordering on every side of Assam, are consumers of alcoholic liquors, yet this habit appears to have never obtained any hold on the neighbouring inhabitants of the plains ; while the habit of opium-eating, once introduced, would appear to have spread with magical rapidity over the province, and to have become firmly and almost universally rooted as one of the most cherished habits of its people.

It would seem that it must probably have been the anti-periodic power they found in opium as a protection against malaria, which caused it to meet with such universal welcome among the fever-stricken inhabitants of these, then, intensely malarious, marshy and jungly, plains of Assam.

The observations of several surgeons, of extensive experience in opium-eating regions, confirms the popular belief that the opium-eater, in the early stages of the habit, while as yet not constitutionally broken by its long continuance, does, as a matter of fact, enjoy considerable immunity from malarial affections.

Rationale
of the for-
mation of
the habit of
opium-eat-
ing.

Action of
opium
against
malaria.

This is the universal popular belief in this region; and we think some weight must also be attached to the geographical limits of extent of the custom, as bearing also on this point, if the accumulated popular experience of generations is to be regarded. The rationale of this action of opium, in counteracting malaria, may have several explanations.

In the first place, opium has distinct and recognised anti-periodic powers. Garrod in his "Materia-Medica" thus speaks of it:—

Direct an-
ti-periodic.

"In intermittent fevers, or agues, opium sometimes suffices for their cure, when given before the time of accession of the cold stage, but there are other remedies which possess greater anti-periodic powers, without the narcotic properties. Opium, however, may be occasionally used in intermittent fever cases with advantage."

Teste Gar-
rod.

Vascular
stimulant
against
chills.

Beyond this, the fact of its being a nervine and vascular stimulant would cause it to have some preservative effect against the chills which so frequently are the immediate determining causes of an ague.

Rationale
of its wel-
come.

It can readily be understood how extended would become the sway of a pleasant seductive vice when coming so strongly recommended by qualities so eminently adapted to the daily needs of a fever-stricken population of marshy, jungly, plains.

Dilatation
of vessels.
Engorge-
ment.

B—*Liver.* *Action of malaria on the Liver*—The direct action of the malarial poison on the liver is to cause dilatation of its blood-vessels, and

general congestion. This, no doubt, occurs in all paroxysms of malarial fevers, together with similar congestion of the spleen, stomach, and duodenum.

These temporary hyperæmias cause intermitting Alterations in function. exaggerations in functions of the liver ; these latter at one time, are over-stimulated, at another time in abeyance.

Hence, inter-current attacks of bilious purging and Excess of, or want of, bile. of flatulent constipation usually complicate malarial fevers.

In these regions of Lower Assam, it is extremely In Assam, acute hepatitis never met with in malarial fevers. rare to find any acute hepatitis complicate malarial fevers, either intermittent or remittent. The writer has never seen such a case. We observe, too, that Morehead and Maclean state a similar fact as the result of their experience.

From repeated attacks of malarial fever, or from Changes in liver become chronic. the slow non-febrile development of the malarial cachexia, the state of dilatation and engorgement of the blood-vessels of the liver becomes confirmed into a chronic state of congestion, and organic structural changes take place.

The malarial liver is found gorged with venous Lesions of the malarial liver. blood ; dark-purple in color, or speckled with patches of dark-pigment ; it is usually slightly enlarged, but rarely to any great extent ; and, if at all altered in consistency, is slightly softened.

From the lobular, distinct, structure of its tissue, From nature of liver structure, the liver does not, from chronic congestion, undergo

chronic
congestion
does not
much
enlarge or
soften it.

any great changes in size; the cellular elements of the lobules may be increased in number, but enlargement of the liver from this cause only proceeds to a limited extent. So also, as this enlargement consists of new liver cells, and additions to the hard liver structure, such increase in the amount of hard tissue does not confer softness.

Rarely met
with much
enlarged or
soft.

The numerous malarial livers the writer has met with, associated with splenic enlargement and gastric engorgement, have rarely been much increased in size, and scarcely ever markedly softened.

Chronic
congestion
of spleen
from
structure
causes
enlarge-
ment and
softness.

The spleen, on the other hand, being a vascular, practically erectile, organ, and having its true tissue formed of pulpy matter of indefinite structure, can, and does, enlarge greatly, from chronic congestion; and, as such enlargement results from an increase in its soft pulp, it is accompanied by increased softness of the gland.

Different
structures,
different
lesions.

The different mode of lesion in the spleen and liver, from the same chronic congestion, is most marked, and results from essential differences in structure.

Symptoms
of conges-
tion of
liver.

This chronic congestion of the liver, in cases of continued malarial poisoning, adds its own train of symptoms to those resulting from the gastric engorgement and the splenic enlargement.

The symptoms referrible to the liver lesions are, however, much less prominent than those arising from the gastric and splenic disturbances.

Excess
of bile
from
hyperœ-

From this hyperœmia of the liver there is, at first, exaggeration of function, and attacks of bilious

vomiting and purging result, which give great relief ^{mia of liver.} to the patient.

The bile is the natural purgative of the system ; it increases absorption and vermicular action in the intestines, by its stimulating action.

Hence the use of inspissated ox-bile as a medicine. ^{Uses of bile.}

It also exerts an antiseptic action on the contents of the alimentary canal, retarding fermentative decomposition, so that matters in the intestinal tract decompose and evolve gases much less than they would do, under the influences of the same heat and moisture, out of the body.

When, to a state of exalted function from hyper- ^{Hence its absence causes constipation and flatulency.} chemia, has succeeded state of reaction and depressed function of the liver, the deficiency of bile causes constipation and flatulency, and the dejecta are clay-colored, or whitish, from absence of bile pigment.

This condition is extremely common in the malarial cachectic, and occasional attacks of it are sure to be met with in the old resident in malarial regions, even though no marked cachexia is present.

This state of depressed function of the liver is ^{Absence of bile also assists to cause dyspeptic diarrhoea.} also a factor in keeping up the dyspeptic diarrhoea above noted as depending on the gastric irritability. The absence of bile prevents complete digestion, and the food is passed on to the lower intestine only half-digested, and, with little nourishment assimilated from it, is hurried on out of the body as alvine evacuations of light-colored chyme.

Influence
of malaria
in produc-
ing
abscess of
liver.

There is little doubt that malaria and heat are powerful predisposing causes to attacks of suppurative inflammation (abscess) of the liver. With regard to the influence of the malarial cachexia in the production of this disease, Morehead regards "external cold acting on a system depraved by the cachexia induced by residence in the tropics as the most frequent cause of hepatic inflammation."

Morehead's
opinion.

In Mala-
rious
Assam
abscess of
liver is
common.

Certainly, in this malarious region of Assam, suppurative inflammation of the liver (abscess) is far from being a rare affection.

Three
cases.

In the year 1878-79 the writer met with three cases in his practice. One was produced in a man, who had long suffered from malaria in these hot plains, on his proceeding to the cold hills on duty, which involved much exposure. The other two cases occurred in persons who had not discontinued their residence in the plains. Both had, for some time, lived in regions remarkable, even here, for their specially malarious character.

Liver
suffers less
from mala-
ria than
either
stomach or
spleen.

It has always seemed to the writer, that the liver suffers, directly, from the malarial poison, whether in its acute or chronic form, in a much less marked manner than either the stomach or the spleen; the symptoms referrible to its involvement are usually the least marked; and its structural organic changes are less characteristic and important than those of either of the other viscera which, with it, are the special subjects of malarial lesions.

CHAPTER III.

ACTION OF MALARIA.

Splenic Enlargements: Temporary and Chronic.

Spleen.—Action of malaria on :—

That the spleen temporarily enlarges during the paroxysm of a malarial fever, and during digestion, is well known.

That it permanently enlarges from repetitions of these fevers, or even from slow, non-febrile, malarial poisoning of the system, is equally admitted. Hence the definition, “Ague cake,” popularly and aptly applied to such chronic enlargement.

This capability of the spleen to undergo either temporary distention with alternative contraction, or permanent hypertrophy, depends on certain peculiarities of the structure of its component parts.

The power of undergoing temporary distention and subsequent contraction depends chiefly on the construction of its framework, (*viz.*:—capsule, trabeculæ, and sheathing canals for its large bloodvessels) and on the number, size, and arrangement of its bloodvessels; in all of which the spleen closely resembles an erectile body, such as the corpus cavernosum.

To a lesser degree, it depends on the true splenic pulp.

Permanent
enlarge-
ment
depend on
spleen
tissue
proper or
pulp.

The liability to undergo chronic enlargement is due, partly to the above-mentioned causes, but chiefly to the presence of the peculiar spleen-substance proper—the pulp—which, supported by the framework and lying among the vessels, forms a large portion of the bulk of the viscus.

In possessing this proper tissue, the spleen differs from other erectile bodies, and is endowed with special capacities and functions.

The three essential parts of the spleen structure, then, are :—

1. *The framework*—Including the capsule, trabeculæ, and sheathing canals for the large vessels.
2. The bloodvessels.
3. The spleen substance proper—pulp.

Structure of the Spleen.

General
structure
of spleen.

The spleen consists of a tough investing capsule, and of a body ; this body is itself soft and easily lacerated, and is made up of a reticular network of elastic bands continuous with the capsule, of an immense proportion of bloodvessels, and of a peculiar intervening pulpy substance.

1. *The Capsule and Framework.*

Structure
of frame-
work.

The capsule consists of an external smooth peritoneal covering, and of an inner, thick, strong, elastic tunic.

It is composed of areolar fibres mixed with fine elastic tissue, and, in addition, there are found pale fibres of unstriped muscular tissue.

Stretching across in all directions, in the intermediate substance of the spleen, are multitudes of minute elastic bands—the trabeculæ; these are prolongations of the capsule inwards, and exactly resemble it in structure.

Prolongations of the capsule form, also, sheathing canals in which the large bloodvessels lie. Any contraction of the muscular fibres of these canals would compress the vessels contained in them.

2. *The bloodvessels*—of the spleen are extremely large and numerous. The smaller arteries, whose thick, muscular, middle coat endows them with great contractility, lie free on the trabeculæ, and terminate, in small tufts of capillaries, in the spleen pulp.

The veins are numerous, and form large plexuses.

The larger bloodvessels and their main branches lie, or are included, in canals formed by the capsule tissue reflected in on them at the hilus. Thus the large arteries, which, from the thinness or absence of their middle muscular coat, have little or no independent contractile power, have this deficiency supplied by their lying in, and being enclosed by, contractile, sheathing, canals from the capsule tissue.

Like other arteries, those of the spleen have an elastic, fibrous, outer coat—a middle, or muscular, one

Capsule.

Trabeculæ.

Sheathing
canals for
vessels.Blood-
vessels of
spleen.Large
vessels
lie in
sheathing
canals.
Contractile.The
arteries.
Structure
of their
coats.

of unstriped, organic, muscular fibres—and an inner lining membrane.

The muscular coat is most thick, proportionately, in the smaller arteries, which possess marked contractile power ; it is thin in the larger arteries, and, hence, these have little contractile power, though, from the thickness of their elastic coat, they are very distensible.

Structure
of spleen
pulp.

3. *The spleen substance proper*—is a soft, pulpy, mass, resembling grumous blood. It lies among the bloodvessels, supported by the trabeculæ. It consists of round bodies—resembling the red blood-corpuscles, in a matrix of cells, nuclei, and granules, resembling blood-corpuscles in varying degrees of disintegration, or formation.

It is, as it were, a *debris*, formed of blood cells in process of elaboration or destruction, not having any definite or permanent structure (as the liver stroma has), shifting and varying in amount according to the quantity and quality of the blood supply.

Elasticity
and con-
tractility
of spleen.

The healthy spleen, its capsule proper, the prolongations of this sent into the spleen substance forming the trabeculæ, together with the sheathing canals containing the large bloodvessels, and the coats of the smaller vessels themselves, are all highly elastic, and endowed with a low form of contractility, owing to their being largely composed of elastic tissue in which are found pale fibres of unstriped muscular tissue.—*Quain*.

The whole of these structures, together, may be conveniently defined as the musculo-vascular system of the spleen. Its musculo-vascular system.

It is owing to this, that the spleen is capable of such great and sudden variations in bulk.

Thus, in the structure of the spleen, we have every condition adapted to permit great and rapid alterations in size. The capsule and trabeculæ are highly distensible, and somewhat contractile; the large vessels are enclosed in sheathing canals of elastic and muscular tissue; the small arteries themselves possess marked contractile power. Great adaptability of spleen to undergo changes in size.

Thus the amount of blood entering the spleen may be limited by the contraction of the sheathing canals diminishing the calibre of the large arteries—their- selves not very contractile; the contractile small arteries, of themselves, joining in; while, by the slow contractile action of the capsule and trabeculæ, sufficient compression may be exerted to limit the amount of blood in the capillaries and veins. Action of the musculo-vascular system of spleen, and action of spleen pulp in assisting changes in bulk of the viscus.

Conversely, all these parts, suffering from relaxation, permit the vessels, and then the viscus itself, to undergo great distention from the force of the blood pressure of the circulation, no longer tonically counter-acted.

These sudden changes in the bulk of the spleen are, also, facilitated by the absence of any stroma of definite, permanent, structure, such as the liver tissue. The spleen pulp is, so to speak, a mass of

debris, constantly shifting and varying in amount according to the varying conditions of the blood supply.

Contractile sheaths for large vessels.

Worthy, too, of special notice, is the arrangement which encloses the non-contractile larger arteries in a contractile sheath, while leaving free the smaller arteries which are, in themselves, highly contractile.

It will be noticed that the construction of the framework of the spleen somewhat resembles that of the coats of arteries, both having elastic tissue and pale unstriped muscular fibres.

Spleen is an erectile body, like corpus cavernosum in structure and action.

So far as its framework and bloodvessels—its musculo-vascular system—are concerned, it resembles strongly, in structure, erectile bodies, especially the corpus cavernosum ; as it does, also, in its capability of undergoing sudden and great changes in size, and in the means by which these changes are effected.

To the special spleen pulp are due chronic enlargements.

It differs from other—merely—erectile bodies, in having, superadded to its erectile structure, a spleen substance proper—the pulp. To the presence of this pulp is due the capability of undergoing extensive chronic enlargement, which mainly depends on increase in the amount of the spleen pulp proper.

In this respect it differs from mere erectile bodies, such as the corpus cavernosum.

The spleen has, in addition to its erectile structure, a special tissue—the pulp—and special functions and capabilities dependant on the presence of this special tissue.

The corpus cavernosum is an erectile body; and this is the beginning and end of its functions.

Corpus cavernosum and spleen contrasted.

The erectile tissue of the corpus cavernosum has no tendency to become permanently hypertrophied from frequent distention.

Nor, probably, has the erectile portion (framework and vessels) of the spleen much primary tendency to do so.

The permanent enlargements are due to hypertrophy of the spleen substance proper (the pulp); increase in the amount of its erectile structure, even if it occurs, is, no doubt, secondary to that.

In spleen, it is the pulp which hypertrophies.

The malarial enlargements, to which the spleen is subject, may be considered separately, as—

Enlargements of spleen.

a. *Temporary* enlargements.

b. *Permanent* hypertrophy.

a. *Temporary enlargements.*

The capabilities of the spleen to undergo great and sudden alterations in size are well known.

Temporary.

During digestion, and during the paroxysm of malarial fevers, such distention occurs; this may disappear and the spleen may resume its normal size again, after the process of digestion, or the paroxysm of fever, is over.

Temporary distention during digestion, or fever.

When any foreign body is introduced into the stomach, from its contact with the mucous membrane, hyperæmia of the vessels of this membrane immediately ensues—no doubt, from the irritating action of the foreign body causing the spinal nerve

Foreign body in stomach, causes hyperæmia of mucous membrane. Why?

fibres to inhibit, or antagonise, the influence of the sympathetic nerve fibres which, ordinarily, keep the muscular coats of the bloodvessels in a state of normal tonic contraction.

During digestion new pabula in blood cause relaxation of the whole musculo-vascular system of spleen.

When food has been ingested, and, from assimilation, the blood contains newly-introduced, crude, pabula, towards the end of digestion, it acts (probably through the spinal nerve fibres inhibiting the influence of the sympathetic) on the muscular coats of the vessels of the spleen, while at the same time, from a similar nervous action, relaxation probably takes place in the similar, unstriped, muscular fibres of the framework (capsule, trabeculæ, sheathing canals of the large vessels).

The muscular fibres of spleen framework and vessels acting in unison.

Thus, the unstriped muscular fibres of the whole of this musculo-vascular system act in unison, and all become relaxed simultaneously.

The sheathing canals of the large vessels become relaxed, as do the muscular coats of the small arteries : consequently, both these yield to the pressure of the circulation, and become distended ; hence, general hyperæmia ensues, and the spleen contains an increased amount of blood. The relaxation of the muscular fibres of the capsule and trabeculæ allows their elastic materials free play, and great distention ensues.

Method of this action.

When the action of inhibition ceases, the influence of the sympathetic is restored ; the muscular fibres of the whole system of framework and vessels of the spleen again resume their normal condition of

tonic contraction—and the gland assumes its smaller size.

Under the influence of malaria, much the same action of dilatation and hyperæmia of vessels of the stomach and spleen seems to occur, except that the malarial poison affects the vessels of all the digestive viscera more or less simultaneously: the stomach, spleen, liver, all become hyperæmic, though this hyperæmia and congestion can cause distention in the spleen only, on account of its vascular, erectile, structure.

In any congestion of the portal circulation, the distensible capsule, and the great size and number of the bloodvessels, of the spleen, cause that viscus, especially, to suffer, by receiving a greatly increased quantity of blood, and, hence, undergoing great distention, becoming, in fact, a diverticulum for the blood of the Portal system.

But, whenever the vessels of the spleen undergo dilatation, and the amount of blood in the viscus is much increased, its functions, with regard to the blood, go on more largely and with increased activity.

In vascular distention of the gland, during digestion, or during a fever paroxysm, there is found an excess of the pulpy substance.

So that these temporary enlargements are not mere distentions from an excess of blood; they are that, together with much increase in the amount of true pulpy tissue.

Malaria acts similarly on the muscular fibres of vessels, &c.

Stomach, spleen, liver, &c.

In any congestion of portal circulation spleen distends.

Is a diverticulum.

When increased amount of blood in spleen,

there is also increase in amount of spleen pulp,

which subsides with the hyperæmia.

On the subsidence of the hyperæmia, this excess of spleen pulp is soon absorbed, it moves on, and disappears.

Function of the spleen.

The special function of the spleen seems to be the formation of the white corpuscles of the blood, and the disintegration and destruction of the red ones at a certain stage of their existence.

In the enlargements of spleen there is excess of function.

In the distention of the spleen during digestion, as the presence of new pabula in the blood affords additional formative material, the elaborative function seems to be especially active, and new cells are formed in great abundance ; white cells are in great excess in the blood coming from the spleen during digestion, and the red corpuscles are in relatively much smaller proportion than in ordinary blood.

In fevers the function of destruction of red blood cells chiefly in excess.

In the distention of the spleen during a malarial fever, on the other hand, it is probable that the function of disintegration and destruction of the red corpuscles of the blood is the one most exaggerated in activity, and that an excessive number of these red corpuscles are destroyed.

Great exhaustion from malarial fevers.

Hence, probably, the great anæmia and exhaustion which these fevers produce, which is greater than that produced by a similar period of the same temperature in any other febrile disorder, and much resembles the effects of a severe hæmorrhage, on the system.

The rapid exhaustion produced by even a short period of malarial fever, and the equal rapidity with

which this is recovered from, are both facts generally acknowledged—indeed household words, in this malarious region.

For the same reason, probably, occurs the deficiency of red corpuscles in the blood, and the intense anæmia and pallor, observable in the malarial cachectic, whose spleen is in a chronic stage of great enlargement. Similarly the anæmia in chronic enlargement of the spleen.

The malarial poison seems cumulative in its action. Malarial poison cumulative. It may be, and often is, eliminated as fast as imbibed, and no definite ill-effects ensue.

Any sudden check to the eliminative organs, such as the skin and kidneys, however, permits accumulation sufficient to produce the characteristic effects of the fever. Any check to its elimination determines attack of fever.

We practically find that, in persons living in malarious regions and constantly exposed to the poison, the immediate developments of attacks of fever are usually traced to chills to the skin.

The malarial miasm is, probably, a true nervine poison, exerting a primary action, through the sympathetic nerves, on the unstriped muscular fibres of the bloodvessels of the spleen and other digestive viscera, and, secondarily, on the blood itself, by excess of, and altered, function of that viscus. Malaria a nervine poison acting through the sympathetic nerves.

b. Permanent enlargements—of the spleen, from malaria. Permanent enlargement of the spleen

From frequent repetition of the changes which take place in the spleen during a paroxysm of malarial fevers, from frequent fevers,

fever (*viz.*,—dilatation of the bloodvessels, and distention of the spleen, with excessive formation of spleen pulp), this hyperœmic condition assumes a chronic form. The distention of the bloodvessels constitutes a chronic congestion, or a low form of inflammation ; and congestive or inflammatory products are exuded, in the form of semi-organisable lymph, or thin serum, which mixes with the spleen pulp.

Spleen in
state of
chronic
congestion
or low in-
flamma-
tion.

The spleen pulp, too, is itself formed in permanent excess. There is reason to believe that the trabeculæ do not increase in number ; nor in thickness, at all in proportion to the increase in amount of spleen pulp.

Spleen
pulp in
excess.

The enlarged viscus may be soft and pulpy, or hard and friable.

From the relative excess of soft, grumous pulp, in such a spleen, as compared with the fibrous tissue and trabeculæ, it is commonly abnormally soft.

The soft
enlarged
spleen.

If congestive serous exudations of a fluid character take place, from the distended vessels, into the pulp, this may be still further softened, and present the consistency of a mere bag of blood.

If, as sometimes occurs, semi-organisable inflammatory products, exuded from distended vessels, have sufficient vitality to undergo a sort of feeble coagulation in the spleen pulp, they, and this pulp, may set into a hard but friable cake, easily broken down.

The hard
friable
enlarged
spleen.

This constitutes the hard, friable, spleen of chronic malarial enlargement.

But, as the trabecular fibrous tissue does not increase with the increase of pulp, the malarially enlarged spleen is seldom, or never, met with of tough, firm, consistence.

Malarial spleen never tough and firm.

The permanent increase in bulk, then, is mainly due to permanent increase in amount of spleen pulp ; to a less degree, to the presence of exudative products of inflammation or congestion, as well as to more or less permanent dilatation of the arteries, and increase in the amount of blood in the spleen.

Permanent increase in bulk due to

Slow malarial poisoning may produce the same effects on the spleen, without the poison, perhaps, ever having been intense enough in the system to cause distinct febrile phenomena.

Effect on spleen of slow malarial poisoning.

In all cases of slow malarial poisoning, the stomach, duodenum, and liver, also suffer from chronic congestion.

In all these cases of permanent enlargement of the spleen, as there is increased blood supply, there is increased function.

As the main functions of the spleen seem to be disintegration of the red corpuscles of the blood, and formation of its white cells, permanent excess of these functions produces a condition of the blood poor in red cells, though abounding in white corpuscles.

Functions of spleen.

Hence we find that, in persons suffering from chronic malarial enlargements of the spleen, the blood is deficient in red corpuscles, while the white

In chronic enlargement of spleen there is anæmia

and want
of red cells
in blood,
forming
malarial
cachexia.

ones are in great relative excess ; and the individuals suffer from the anæmia and leucocythemia, constituting the well-known malarial cachexia.

This seems to be due to the exaggeration and perversion of function of the spleen—which depend on the muscular tissue of the blood-vessels being affected, through the sympathetic system, by the action of the poison.

Changes in
capsule
and trabeculæ.

Owing to the low form of inflammation set up by chronic hyperœmia of the spleen, the capsule and trabeculæ become infiltrated with an excess of white fibrous tissue, (like the liver in cirrhosis), and, as this preponderates over the elastic tissue, and overwhelms the muscular fibres, the spleen framework loses its power of contractility, and of elastic distensibility and resilience. The spleen is thus reduced eventually to a more or less permanent and unvarying size, and, even when emptied of blood (as in rupture, or wound) still has no power to contract or resume a smaller size, but looks like the large body it was, only somewhat collapsed, wizened, empty, and flabby.

Changes in
capsule
detailed.

In chronic malarial enlargements the capsule of the spleen usually is dull, opaque, white, and more or less thickened—but rarely to a degree at all proportionate to the increase of the viscus in bulk.

In rare instances, it becomes enormously thickened, and forms a dense covering as thick and tough as chamois leather, as in case 35 (Part II), in which

instance, such a capsule remained intact after the occurrence of violence sufficiently severe to shatter extensively the soft spleen substance inside it.

Resumé.—The malarial poison, then, produces chronic congestion of the spleen, liver, stomach, and duodenum. *Resumé.
Malarial
changes in
spleen,
liver,
stomach.*

From a continuance of this, certain structural changes result, varying according to the structural peculiarities and capabilities of each viscus. In the spleen, this chronic congestion produces excess of its true pulp, and exudations of fluid serum or of semi-organisable lymph, producing an enlarged and either a soft or a friable condition of that viscus; in the liver, engorgement of venous blood, a dark—often mottled—color, and some increase in weight and size; in the stomach, venous congestion, dark discoloration and thickening of the mucous membrane, with, sometimes, an amount of gelatiniform thickening of the sub-mucous tissue—strongly resembling similar changes in the Rectum in Chronic Dysentery.

Extent of Chronic Enlargements of the Spleen.—*Normal
weight.*
Owing to the structural peculiarities noted in the preceding paragraphs, the spleen is capable of undergoing changes in size to a striking extent.

Thus, Quain says, that, though in health it weighs from 5 to 7 ounces, yet in intermittent and other fevers it attains a weight of from 18 to 20 pounds. In solid enlargements it has been known to weigh *Weight
sometimes
attained.*

upwards of 40 pounds ; while it has been found reduced to two drams in weight.

Weights
attained in
the present
cases.

Among the writer's cases (as detailed in Part II), certain ruptured malarial spleens weighed, after the blood had been washed off them and out of their wounds—

One ... 44 ounces.

One ... 28 ounces, in a boy aged fifteen years.

One ... 28 ounces, in a child aged twelve years.

Extent of
enlarge-
ment and
its direc-
tion.

In malarial enlargements, the spleen is usually found well below the protection of the lower ribs (it, normally, should lie entirely behind them); it is frequently found extending to the umbilical region; the writer has seen it reach to the pubes, having encroached on the whole abdominal region like a gravid uterus, which it much resembled.

Direction
of enlarge-
ment.

In the second part of these papers, it is discussed why the enlarging spleen extends chiefly downwards. It, no doubt, tends to enlarge in every direction, but as its encroachments are limited on every side but the downward one, this, aided by the action of gravity, determines the encroachments chiefly downwards.

Rationale
of the ex-
tent of
spleen
downwards

For above it, there is the diaphragm, intermittingly tense during respiration ; on its inner side, lies the stomach, periodically distended with food ; behind it, lie the left kidney and the unyielding spine ; round the outside, it is encircled by the bony framework of the ribs. Consequently, no great enlarge-

Its sur-
roundings,
influence
of.

ment can take place in these directions ; while the mobile, elastic, intestines oppose no bar to its unlimited descent into the abdomen.

The enlarged malarial spleen is usually softened in varying degrees. It is often of the consistency and appearance of a large bag of blood ; in this case there often seems to be a condition of dropsy of the viscus ; that is, in addition to excessive increase in the amount of spleen pulp, there appears to be present, fluid exudations from the congested vessels—much as occurs in other parts similarly situated with regard to stagnation of blood in dilated, congested, vessels, (as in Ascites, arising from distention of abdominal veins, as a result of obstruction to the circulation through the liver, in cirrhosis of that organ).

The enlarged malarial spleen is sometimes friable, but this form is less frequent than the soft condition. In this state, it has a spurious, superficial, hardness, but easily breaks down, like a feebly coagulated clot, on the application of the slightest force, and seems more easy of rupture than the soft variety.

This consistency seems to result from an exudation of inflammatory lymph, from the distended vessels, possessed of a feeble coagulating power, which has the effect of setting into a cake among the soft spleen pulp.

In one instance, the writer has met with a malarially affected spleen very small. This was in a man by name Banchit Ghose, dissected on 28th September,

Consistency, alterations in.

Very soft diffuent condition.

Frequency of the friable and of the soft condition.

Rationale of friable spleen.

Instance of an excessively small malarial spleen.

1879.—The spleen was small, flat, three inches long, two inches wide, but only one-third of an inch thick, so thin, indeed, as to weigh only one ounce and nineteen grains. In color, it was black-violet. It was very soft, but uninjured. The vessels at the hilus were also atrophied and small. The capsule was excessively thin and diaphanous. The spleen tissue seemed to have atrophied and disappeared, only the pigmentary matter, in a diffuent state, remaining.

Atrophied
and highly
pigmented.

This is the smallest spleen the writer has ever met with. He has made a preparation of it.

This man had passed his life in a very malarious region. The atrophy probably arose from other than malarious causes, but occurred in a malarial cachectic.

Extent of
changes in
capsule of
spleen.

The capsule of the spleen usually participates in the chronic inflammatory condition of the viscus which obtains in its permanent enlargements. From being glossy and smooth on its peritoneal surface, it becomes rough and opaque ; its elastic tissue and muscular fibres become clogged by depositions of plastic lymph from the hyperæmic vessels ; it becomes thickened, and its elasticity and contractility become impaired, or lost.

Thick capsule gives support.

This thickening is usually sufficient to give some degree of support to the hypertrophied viscus, but quite inadequate to confer any great protection on it.

Very thick capsule may protect.

Occasionally, but very rarely, the capsule becomes so immensely thickened, by deposition of large

amounts of plastic lymph, that, in toughness, and thickness, it resembles chamois leather. Case No. 35, (Part II), illustrates this condition.

In this condition, it may confer considerable protection on the enclosed spleen mass, and, at any rate, does not itself easily undergo rupture. In case No. 35, (Part II), it remained entire whilst the contained spleen mass was shattered to pieces.

In the case of small malarial spleen above mentioned, the capsule was thin and diaphanous—a mere film, in fact.

This condition the writer has never seen in any other malarial spleen, and in this case, it was probably due to some other influence than malaria.

The enlarged spleen, as a rule, is not the seat of pain, in any stage of its development. The patient suffers no direct inconvenience. He usually notices the increase in size, the value of which every one in these malarial regions is sufficiently well versed in such matters to appreciate. He comes for treatment complaining that his spleen is large, not that it is painful.

Even during the inflammatory enlarging process, when the capsule is also involved, there is little or no pain, whatever distressing symptoms exist are referred to the stomach, and only the size of the spleen is complained of.

In the state of marked enlargement, but slight violence is needed to cause a rupture of the spleen, especially

Small malarial spleen.

Enlarged spleen not the seat of pain or inconvenience.

Even while capsule is suffering, there is little or no pain.

Enlarged spleen easily ruptured.

cially if it be in close contact with a stomach hard and distended with a mass of food, on its innerside.

Very soft spleen liable to spontaneous rupture from action of abdominal muscles.

In certain cases in which the spleen has been like a thin bag of blood, reaching through the abdomen to the pelvis, and resembling a gravid uterus at its largest, a very trivial amount of force would be sufficient to rupture it ; and, in two instances, the writer has been in constant expectation that a sudden contraction of the abdominal muscles (as in straining at stool) should, by compressing it against the spine, or the full stomach, be sufficient to cause, so called, spontaneous rupture.

Such cases very rare.

Among the many hundreds of cases of enlarged spleen that have come under the writer's notice, he has never met with a case of spontaneous rupture.

Cachectic thinning of abdominal muscles.

Usually, with a spleen of this degree of enlargement, there is marked cachexia, and the abdominal muscles, like those of the rest of the body, become thinned. This thinning suffices to render spontaneous rupture less probable, by rendering violent action impossible.

Spleen pendulous.

The writer has sometimes met with the plane of abdominal muscles so thin and lax that the abdomen was quite pendulous from the gravitation downwards of the enlarged spleen, and needed a stout waistcloth to support the drooping viscus.

Enlarged spleen not distended.

The writer questions if the permanently enlarged spleen undergoes the distention during a paroxysm of fever, which a fairly normal one does.

He has often carefully gauged the exact dimensions

of a permanently enlarged spleen, both during a fever paroxysm, and when the patient was quite free from fever, without being able to detect any variation in size ; though the variation of a fairly healthy spleen, in size, before, and during, a febrile attack, was usually detectible.

Malarial Cachexia.

From prolonged exposure to malaria—as during residence in miasmatic regions—a depressed state of general health and anæmic condition of the system are produced—termed the “malarial cachexia.”

This condition of constitution may come on insidiously without any febrile manifestations.

Malarial
cachexia.

Insidious
non-febrile
invasion.

Professor Maclean notes, in speaking of malaria—“by its depraving influence on the constitution it often silently undermines the health without the manifestation of any febrile phenomena.”

This condition of the system is practically one of malarial leucocythemia.

Condition
of the
blood in —

The blood contains an excess of water and of white corpuscles, while the red cells are relatively much diminished in quantity. The countenance exhibits pallor, and an anxious expression; and all the functions of the body are carried on in a depressed, imperfect, manner.

Symptoms
of—

This is especially true of the functions of digestion. Chronic gastritis, dyspepsia, with intercurrent attacks of diarrhœa—the motions consisting largely of chyme—are commonly observed symptoms.

Derange-
ments of
digestive
functions.

Malarial
diarrhœa.

Dr. E. Goodeve assigns, as one cause of those diarrhœas due to constitutional derangements, chronic malarious complaints, with enlarged liver and spleen.

Goodeve's
views.

He further observes that a frequent cause of the chronic diarrhœa—known as white flux, from the paleness of the motions—or as cachectic diarrhœa—is the direct or indirect action of malaria acting feebly and slowly on the system.

He, consequently, advocates the use of quinine in all such cases.

Diarrhœa,
primary or
secondary.

Opinions are divided as to whether this cachectic diarrhœa is a primary result of the action of the malarial miasm, or is secondarily dependant on cachectic condition, and on visceral changes, due to the action of the miasm.

Views of
Goodeve
and of

Professor E. Goodeve remarks :—"Diarrhœa often
"prevails in malarious countries without proceeding
"to obvious cachexia, and its mode of production in
"them affords matter for discussion. It is doubtful
"whether it arises directly from the action of mala-
"ria, or whether this acts merely as a predisposing
"cause, by which the system becomes readily sus-
"ceptible to the external impressions causative of

Morehead.

"diarrhœa. The high authority of Morehead is in
"favour of the view which restricts malaria to a pre-
"disposing action only ; but, with due deference to
"his opinions, the writer finds it hardly possible to
"escape the conclusion that, in a certain number of
"cases, the flux may come on in an early stage of

“contamination of the system, before recognizable
“cachectic influences appear, and where external im-
“pressions are not traceable.”—(Reynolds’ System of
Medicine, Vol. I, p. 645, *et seq.*)

The present writer’s experience coincides with that of Professor Goodeve. He has frequently met with cases of constitutional pale diarrhœa, manifestly due to malaria, in persons suffering from no recognizable cachexia.

The present writer has been led by extended series of observations, to ascribe the gastric symptoms, the dyspepsia, the pale diarrhœa, and the cachexia, all as secondary to the chronic visceral changes occurring in the stomach, duodenum, liver, and spleen, from the prolonged action of the malarial poison—in contradistinction to the view that holds the cachexia to be a primary symptom, to which the gastro-duodenal symptoms, and diarrhœa, are themselves secondary.

Whether the condition of cachexia is one resulting primarily from the depraving action of the malarial poison on the blood, or is secondary on those changes and lesions of the digestive viscera which are characteristic of the action of the malarial poison, is not certainly ascertained.

It can, however, be readily conceived that a state of permanently-impaired, defective, nutrition of the body would ensue from the condition of the digestive viscera previously described as resulting from the action of malaria. Probably, no case of marked

Present
writer’s
experience.

Diarrhœa
and ca-
chexia
secondary
to visceral
lesions.

This
cachexia
primary or
secondary
to the
visceral
lesions.

Malnutri-
tion of
body, result
of visceral
lesions.

No
cachexia

without
visceral
lesions.

malarial cachexia is unattended by the visceral derangements due to the miasmatic poison.

The depraved
condition
of blood
due to
lesions of
spleen.

The altered and excessive function of the malarially enlarged spleen seems to produce a depraved condition of the blood, characterized by an excess of white cells, and a relative deficiency of red ones.

Teste
Kirke.

According to Kirke, no case of leucocythemia is unattended by enlargement of the spleen, and the malarial cachexia is essentially a leucocythemic condition.

Malnutri-
tion due to
lesions of
stomach
and liver.

The malarial derangements of the stomach and liver seem to produce impaired digestion and imperfect assimilation of food, leading to defective nutrition of the body.

In malar-
ial
cachexia,
spleen
always
enlarged.

Among some hundreds of cases of confirmed malarial cachexia, the writer has never seen one in which the spleen was not enlarged; though sometimes this enlargement was not very decided, in none was it entirely absent, and, in the majority of the cases, the hypertrophied spleen could be distinctly felt reaching below the protection of the lower ribs to a greater or less distance.

The
"cachexia"
secondary
to the
visceral
changes.

The writer is inclined to regard the condition of the system known as the "malarial cachexia" as a secondary one, dependant on the visceral changes which are the essential results of the miasmatic poison.

Evidence.

By merely reducing the size of an enlarged spleen—by the use of the ointment of the bin-iodide of

mercury—the general cachectic condition of constitution is greatly benefited, even though no internal remedies are used to act on the system.

As the spleen returns to its normal size—so the patient tends to regain a normal condition of health, even in cases in which no element of uncertainty, as to the cause of this change, is introduced by any exhibition of other medicine, or by any change of climate. Unless we credit the red iodide of mercury, when used externally and locally, with tonic powers which it has never been known to possess, we must admit that the subsidence of the cachexia and the re-establishment of health are due to the reduction in the abnormal size of the spleen; and, in admitting this, we concede that the constitutional condition of cachexia depends on, or is secondary to, the hypertrophy of the spleen—and, consequently, that, to a considerable extent, the visceral changes are the primary ones. The symptoms of this cachexia are those of the visceral affections of which it is itself little more than a symptom—together with those of intense anæmia.

The depressed condition of constitution constituting the malarial cachexia tends to predispose to many diseases, and, according to Parkes, it tends to shorten the mean duration of life.

Morehead records that it predisposes to the production of liver abscess. He regards “external cold, acting on a system depraved by the cachexia pro-

By reducing size of the enlarged spleen the condition of health much improved, even though no other means be used to treat the cachexia.

Cachexia ceases as the spleen is reduced in size.

Cachexia dependant on the enlargement of spleen and therefore secondary.

Cachexia shortens life.

Predisposes to liver abscess.

duced by residence in the tropics, as one of the most frequent causes of hepatic inflammation." Later observations have confirmed this view. Like other conditions of intense anæmia, this cachexia lessens the resisting power to cold and the capabilities of the system to accommodate itself to sudden changes in temperature, and thus produces a potential tendency to diseases of bowels, liver, and lungs. There seems good reason to believe that, by lowering the condition of nutrition of the tissues generally, it predisposes to degenerative changes—especially of the large bloodvessels—thus being one cause of aneurisms.

Lessens
resisting
power to
cold.

Predis-
poses to
disorders
of bowels,
liver,
lungs,

and to
diseases of
large
vessels—
aneurism.

Symptoms
arising
from
lesions of
stomach
and liver:

The malarial cachectic usually suffers, to a greater or less degree, from the symptoms, detailed in Chapter II, as resulting from imperfect and altered function of the digestive organs—stomach and liver—

Dyspepsia, from irregular or defective appetite, dyspepsia, attacks of diarrhœa or of flatulent constipation, from chronic deficiency of bile, from fits of mental depression, and from loss of muscular vigour. He is frequently a martyr to periodic neuralgias. In very marked cases, there is also a tendency to œdematous swelling of the depending portions of the body, as occurs in other cases of intense anæmia.

Bowel
irregulari-
ties.

Bilious
derange-
ments,
depression,
neuralgias,
œdema.

Nature of
fever of
the mala-
rial ca-
chectic.

The malarial cachectic may, or may not, suffer from intermittent fevers, but, if he does, it is frequent to find that his fever consists of a mere hot stage—a period of pyretic malaise, or a mere flush of

heat, with headache,—lasting for some hours, during which the temperature rises to 101° , or 102° , F° .; no distinct cold stage, or sweating stage, being present.

The symptoms, in many of these cases, lead one to watch for Abscess of the Liver, but are, happily, most commonly, quite independent of this grave affection.

Suggests
Liver
Abscess.

In the neuralgias of the malarial cachectic some of the branches of the fifth are, almost invariably, the nerves affected, and, in by far the greater number of cases, the first division of the fifth nerve is the branch involved. The pain is, most commonly, over the region supplied by the ocular and supra-orbital branches; hence, the term “brow-ague” had origin.

Nature of
malarial
neuralgia.

Fifth nerve
usually
affected,
and the first
division of
this nerve.

“Brow-
ague.”

Ordinarily, one side only is affected, and, in the same person, the affection is, usually, constant to the same side in its recurrences.

Quotidian neuralgia seems the most frequent form, just as quotidian ague is the form most frequently met with. Malarial neuralgia seems to assume the same type as the ague from which the patient may have suffered.

Quotidian
neuralgia
most
frequent.

Usually, each neuralgic attack is, in itself, a feeble, faintly-marked, ague fit; having a slight, but more or less perceptible, cold stage, as the pain begins, and a pyretic stage, co-extensive with the duration of the neuralgia, the temperature rising to 101° , but rarely beyond.

In malarial
neuralgia
—each fit
is usually
an ague
with each
stage
present.

Local perspiration.

A fit of perspiration, often copious, but quite local, over those regions only which are supplied by branches of the fifth nerve, often terminates the attack. (*Vide* Reynolds' System of Medicine, Vol. II, p. 738.)

Malarial neuralgia of ovary—quotidian.

The writer has had under his care a case in which a malarial-cachectic suffered from ovarian neuralgia of a distinctly quotidian type.

In this case, too, a rise in temperature, of from two to three degrees, came on at the invasion of the neuralgia, and was co-terminous with it.

Only yielding to quinine.

Quinine gave marked and permanent relief, and was the only remedy that had any pretensions to be termed curative, or even palliative.

Meaning of the term "cachexia."

All "cachexias" practically one.

By "cachexia" is, practically, meant a condition of anæmia and depressed vitality, and this condition, or "cachexia," is the same, in point of fact, whether produced by malaria, by syphilis, by cancer, or by rectal, abdominal, or suppurative, diseases. Whatever disease, or condition of the system, interferes with the functions of digestion and assimilation, will produce an anæmic, depraved, state of general health, or "cachexia." That the "cachexia" induced by one disease differs practically from that induced by another disease—*i. e.*, that there is a special malarious, syphilitic, cancerous, &c., &c., "cachexia"—is not to be maintained. When we say a patient is "cachectic," we practically mean that he is looking ill—beyond this, the phrase has no precise meaning.—

in fact a "looking-ill."

Bryant.

CHAPTER IV.

THEORY OF THE MODE OF ACTION OF MALARIA.

THE malarial poison is assumed to act through the blood, but the exact mode of production of its lesions is not yet ascertained. Mode of action of malaria.

The writer advances a theory, on the subject, which, he thinks, will satisfy one of the main conditions of a reasonable hypothesis, namely, suffice to explain all the known phenomena of the subject.

In considering this question, it is necessary to premise a few observations on the structure and peculiarities of the pale, unstriped, muscular fibres—the involuntary muscles of organic life—and on the structure of arteries, and of the spleen framework ; though, in doing this, we are compelled to repeat much of what has been said, in a previous chapter, on the structure of the spleen. Preliminary observations on unstriped muscular tissue, on spleen structure, and coats of arteries.

These pale, unstriped, muscular fibres are the variety met with in the numerous contractile tissues of organic life—not under the influence of the will. Pale unstriped muscular fibres.

They are met with in the uterus, stomach, intestines ; in the fibrous framework of the spleen and Regions met in.

corpora cavernosa ; in the middle coats of arteries ; and in other situations.

Structure
of arteries.

The arteries of the body are composed, ordinarily, of three coats,—an outer, elastic ; a middle, formed of these pale, unstriped, muscular fibres ; and an inner lining membrane.

Muscular
coat of
large arte-
ries and of
smaller
arteries.

In the larger arteries, the muscular coat is thin or entirely wanting, and these possess little or no contractility ; their outer elastic coat is very thick and strong, and they possess great elasticity and power of distention and resilience. As the larger arteries lie near the heart—the great motor power of the circulation—they do not need muscular contractility, but do require much elasticity to regulate the current of the blood.

In the middle-sized arteries, the muscular coat is thicker ; in the small arteries, it is the thickest of the coats, and they possess great contractility — thus being able to control and assist the circulation in parts distant from the motor power—the heart.

Spleen.

The elastic framework of the spleen consists of capsule, trabeculæ, and sheathing canals in which the larger vessels lie.

Its capsule.

The capsule consists of (besides its outer serous coat) an elastic tunic formed of areolar tissue, with bundles of elastic fibres, among which lie pale fibres of unstriped muscular tissue.

Sheathing
canals for
the large
vessels and
branches.

This coat is reflected in, at the hilus, so as to form elastic sheaths, or canals, which enclose the large vessels and their principal branches.

Prolongations of the capsule tissue stretch across, in every direction, between these sheaths, and traverse the intermediate substance of the spleen ; these are very numerous, and form the trabeculæ which support the capillary and venous plexuses and the spleen pulp.

The proper coat, the sheaths of the vessels, and the trabeculæ, being all formed of elastic tissue and containing fibres of unstriped muscle, form a framework extremely distensible and endowed with a low form of contractility ; in the meshes of this, lie the vessels and the red spleen-tissue proper—the pulp.—*Quain.*

The Vessels of the Spleen.

The large vessels lie in the contractile, elastic, sheaths, described as being formed of the spleen framework ; and, as these vessels, themselves, have little or no contractile power, their calibre is regulated by the contractility of these sheathing canals enclosing them. Thus, these arteries are practically endowed, in the spleen, with an adventitious external muscular coat, which they lack elsewhere.

The smaller arteries, in themselves contractile, lie, free, on the trabeculæ, and, eventually, end in capillary tufts, which, with the venous plexuses, lie among the spleen pulp, supported by the trabeculæ.

The unstriped muscular fibres, in whatever situation found, are under the control of the sympathetic, or ganglionic, nervous system.

Trabeculæ.

Elasticity and contractility of framework of spleen.

Vessels of spleen. Large.

Their calibre controlled by the sheathing canals.

Smaller arteries are contractile.

Unstriped muscle under control of the sympathetic.

Spinal and cerebral fibres also.

These ganglia, however, receive fibres from the cerebral, and from the spinal, nerves, and, hence, the cerebro-spinal nervous system, also, influences the unstripped muscles.

Action of sympathetic nerves.

The action of the sympathetic, on these muscular fibres of the vessels, is to keep up contraction.

In the ordinary state, it keeps these muscles in a state of normal, tonic, contractility ; when stimulated to greater action, it causes more powerful contraction of the muscular fibres.

Stimulus to this nerve causes excessive contraction.

Thus the local application of cold, or electricity, to the sympathetic nerve fibres, causes these contractions, whether in the bloodvessels, or any other structures containing unstripped muscular tissue.

Cerebro-spinal nerves are antagonistic to the sympathetic.

The action of the cerebro-spinal nerves seems to, primarily, inhibit the influence of the sympathetic, and so, secondarily, influence the unstripped muscles. They seem to be antagonistic to the sympathetic, and to inhibit its action on the unstripped muscles.

Increased spinal nerve action paralyzes sympathetic.

Thus, in a normal state, these spinal nerve fibres just regulate the degree of influence of the sympathetic, and allow it to exert sufficient action to keep up a normal state of tonic contractility of the muscular fibres.

Removal of spinal nerve action results in excessive action of sympathetic.

Increased action of the spinal nerves, from any stimulus, inhibits, or suspends, the influence of the sympathetic, and the muscular fibres become relaxed and limp. Withdrawal of the influence of the spinal nerves results in excessive action of the sympathetic,

causing contraction of the muscular fibres, and closure of the vessels, as occurs in blanching from terror, &c.

When, by any influence conveyed through the cerebro-spinal system, the action of the sympathetic on the small arteries is inhibited, the muscular fibres of its coats lose their contractility and undergo relaxation.

Now, the blood, in circulating, exerts a pressure on the bloodvessels—this pressure, in the human aorta, is equal to more than four pounds.

When, therefore, the muscular fibres of an artery are relaxed, they cease to oppose this pressure, and distention of the vessel ensues, causing increased supply of blood to the part, and general hyperæmia of all its small vessels.

This, then, is what takes place when the action of the sympathetic, on the muscular coat of an artery, is inhibited, or removed.

That the inhibitory action can be exerted by either the cerebral, or the spinal, nerves, we see from such examples as the following :—

The emotion of nervousness causes inhibition of the sympathetic nerves of the vessels of the face and neck, resulting in dilatation of these vessels with blood, and general hyperæmia of the contiguous small vessels, causing blushing.

By the temporary paralysis of the cerebro-spinal nerve fibres, in terror, their antagonistic action, on the sympathetic nerves, is withdrawn, hence excessive

Pressure of
blood on
the circu-
lation.

Vessel
distended
by this
pressure.

Inhibition
of sympa-
thetic.

Examples
by cere-
bral,

Blushing.

Blanching
—from
terror.

action of these latter nerve fibres causes contraction of the muscular fibres and closure of the vessels ; consequently, the blood supply of the part being cut off, the part becomes pale and blanched.

In both the above instances, the face is the part chiefly affected.

Erotic thoughts—on corpora cavernosa. Thoughts of food, causing “mouth to water.”

Similarly, erotic thoughts may cause hyperæmia of the corpora cavernosa. Thoughts of tasty food may cause similarly produced hyperæmia of the vessels of the salivary glands, causing an increased secretion of saliva—it “makes the mouth water,” in popular phrase.

In all the above cases, the primary stimulus was a mental emotion—conveyed through the cerebral nerves.

Similar action of spinal nerves in digestion.

The action of the spinal nerve fibres, in inhibiting the influence of the sympathetic, is seen—in the stomach, when contact of food, or of any foreign body, causes immediate hyperæmia of the vessels of the mucous membrane.

The muscles of spleen framework are like those of vessels; and under same influences.

The unstriped muscular fibres contained in the tissue of the spleen framework—the capsule, trabeculæ, and sheathing canals for the large vessels—are of a kind similar to those in the muscular coats of arteries; and, like them, are governed, in the same way, by the sympathetic, and influenced by the spinal nerves.

They all act in unison—in spleen.

Thus, all the components, of the system of muscles of framework and vessels, can act in unison, in the spleen, on the same stimulus.

The changes which take place in the vascular condition of the stomach, spleen, and liver, during digestion, are so similar to what appears to take place during the temporary influence of a paroxysm of malarial fever, that a study of these changes is both interesting and instructive.

Vascular changes during digestion similar to those due to fever.

When food, or any foreign body, is introduced into the stomach, we know that the result is that the bloodvessels immediately dilate, and the mucous membrane becomes of a deep red color, from capillary dilatation and hyperæmia. This is proved by the exact experiments of Dr. Beaumont on Alexis St. Martin (who had a fistulous opening into the stomach, through the abdominal walls, from a gunshot injury, and who, thereby, greatly advanced our knowledge of the physiology of the digestive process).

Introduction of any solid body, even the bulb of Dr. Beaumont's thermometer, immediately caused this turgescence of the bloodvessels of the mucous membrane.

When food is introduced, and digestion goes on, from continual contact with the ingested substances all the bloodvessels of the stomach become dilated.

Action of food.

The same holds of the vessels of the intestines, when the food is, eventually, passed on to them.

To such an extent are the numerous bloodvessels of the stomach and intestines capable of dilatation by irritation of foreign bodies, or of particular substances, that this method of determining blood from the head,

This action used to determine blood from the head.

in brain congestions, is frequently adopted in medical treatment, *viz.*, stimulating the alimentary tract by irritative purgative drugs.

This hyperæmia caused by the mere contact.

That this turgescence of the vessels of the stomach, on introduction of a foreign body, may be caused by the mere contact, without the influence of substances absorbed into the blood, is shown by its being caused, in Alexis St. Martin, by such a body as the glass bulb of the thermometer introduced by Dr. Beaumont.

This action is by nervous impression.

The action is, then, primarily and essentially, one caused by nervous impression.

The dilatation of the bloodvessels results from the action of the sympathetic being inhibited; the muscular fibres of the vessels becoming consequently lax, the force of the circulation then distends the vessels.

Action how exerted.

This inhibitory action on the sympathetic is, no doubt, exerted by the spinal nerves communicating with the ganglia of the sympathetic supplying the part, excited to action through the irritation communicated to them by the contact of food or of the foreign body.

During digestion—the hyperæmia is of spleen and all digestive viscera.

During digestion, not only do the bloodvessels of the stomach and intestines, but those of all the digestive viscera, become dilated. The spleen, and liver, are chiefly acted on towards the end of digestion, when the newly assimilated pabula have entered the blood.

Details of changes during distention.

As the spleen is, essentially, a vascular gland—containing an enormous number of bloodvessels—and

has a framework (consisting of capsule, trabeculæ, ^{of the spleen,} and sheathing canals of the large vessels) resembling, somewhat, the coats of the bloodvessels in structure, in distensibility, and in presence of the unstriped muscular fibres under the influence of the sympathetic, this general inhibitory action on the sympathetic extends also to the spleen ; hence, these muscular fibres in the capsule, trabeculæ, and sheaths of the vessels of spleen, and in the coats of its small arteries, become relieved of their tonic contraction, and relaxed ; thus yielding to the pressure of the circulation, the vessels become dilated, while the framework of the spleen, also yielding to the distention from general engorgement of all its vessels and increased amount of blood present in it, becomes much enlarged in size. This occurs chiefly towards the end of gastric digestion, and, probably, from the action, on the nerves, of matter introduced into the blood during that process.

As long as the presence in the blood of this new ^{Details of changes in recovery of spleen from this distention.} pabulum, in the condition as at first assimilated, continues to cause stimulus of the spinal nerves, this inhibition of action of the sympathetic continues, and the engorgement of the spleen remains.

Soon after digestion is over, this action ceases ; the influence of the sympathetic is restored, the unstriped muscular fibres of the whole musculo-vascular system (framework and vessels) of the spleen are restored to their normal state of tonic contraction, the small

arteries resume their normal size, the amount of blood in the spleen is reduced to its ordinary amount, and the spleen framework slowly contracts, from the resumed action of the muscular fibres and the resilience of its elastic tissue recovering from previous distention.

Thus the definition of the spleen as a diverticulum for the blood of the abdomen is an anatomical fact.

Distention of the Spleen during Fevers.

Many conditions which re-act on the sympathetic may cause inhibition of its action, locally, and so dilatation of the bloodvessels of some special part.

Stimuli
causing
local action
of sym-
pathetic.

Thus the stimulus of cold, or of electricity, causes local contraction of the unstriped muscular fibres of arteries, or of any other structure containing those fibres.

Emotions
causing
similar
local
action.

We have seen that certain emotions, acting through cerebro-spinal system of nerves, cause local inhibition of the influence of the sympathetic, and, thus, suspension of its action in keeping the small arteries in a state of tonic contraction; hence follows dilatation of the vessels of the part.

Blushing.

Erection.

Salivation.

For example, blushing is caused by such dilatation of the vessels of the face and neck; erection of the corpora cavernosa by erotic thoughts; rapid increase in the secretion of saliva, from dilatation of the arteries of the salivary glands, from thoughts of tasty food.

In these instances, we have local action on the sympathetic and bloodvessels from mental emotional causes, manifestly exerted through the cerebro-spinal system of nerves. Local action on sympathetic caused by mental emotion.

Why the emotion of nervousness should cause local action on the sympathetic and vessels of the face and neck, especially, is not known ; or why, in the other case, a general emotion should cause local action only on the vessels of the corpora cavernosa.

There is, then, no difficulty in conceding that influences acting on cerebro-spinal nerves may cause only local action on a certain particular region or organ. General influences may cause local results.

Again, certain substances, when present in the blood, have the power of exciting or inhibiting the action of the sympathetic on the bloodvessels, and that quite locally, or on the unstriped muscular fibres of some other structure. Action of substances in the blood.

Thus, strychnia in the blood causes dilatation of the arteries of the spinal cord ; belladonna, or conium, causes contraction of the arteries of the spinal cord ; ergot is well known to excite contraction of the unstriped muscle of the gravid uterus, and also to cause contraction of the arteries of the spinal cord. Strychnia, Conium, Belladonna, Ergot.

All these actions are, no doubt, exerted through the spinal nerves influencing, locally, the sympathetic and so the muscular fibres of the bloodvessels or of other structures. Mode of action.

Local
action.

These matters in the general circulatory system are seen to exert their action, quite locally, on the unstripped muscles of organs or vessels of a certain part only.

Malarial
poison in
blood ex-
erts its
influence
locally on
the sympa-
thetic.

It will, therefore, not be astonishing to find that the presence of the malarial poison in the blood is capable of exerting such local action on the sympathetic controlling the musculo-vascular system (blood-vessels and framework) of the spleen, and the vessels of the stomach, duodenum, and liver; on which viscera the action of the poison of malaria is chiefly exerted.

This ac-
tion seems
certain.

That the malarial poison has this effect of dilating the bloodvessels of the spleen, and causing great hyperœmia and distention of that viscus, seems certain.

The
mode of
exertion of
this action.

It is probable that the mode of action is the influence exerted, by the poison of malaria in the blood, on the spinal nerve-fibres of the sympathetic ganglia, and so, secondarily, its inhibitive action on the sympathetic nerves of the muscular fibres of the blood-vessels and framework of the spleen—just as we have seen ergot, strychnia, belladonna, &c., to exert their action when in the blood.

Like
ergot,
strychnia,
&c., so
malaria in
the blood
exerts this
local action
on vessels
of digestive
viscera.

Moreover, just as presence of ergot in the blood exerts an action on the organic, unstripped, muscles of the uterus; just as strychnia and belladonna act on the muscular tissue of the arteries of the spinal cord; so, also, the malarial poison in the

blood, exerts a special, local, action on the muscular coats of the vessels of the digestive viscera—the stomach, duodenum, spleen, and liver.

That the stomach, and duodenum, participate in this hyperæmia, during a malarial fever, is shown by the fact that persistent vomiting, and irritability of the stomach, are never entirely absent in these fevers, and are, commonly, the most obstinate, prominent, and distressing, symptoms. There is, moreover, usually, marked tenderness over the gastric region. *Post mortem* appearances, also, verify this. That the liver, also, participates, seems equally certain.

Stomach and duodenum participate in this action.

Proofs:

Liver also.

Why ergot, when in the blood, should act locally on the uterus, and the malarial poison especially on the spleen and digestive viscera, we do not know; any more than we know why one mental emotion should cause the hyperæmia to take place over the face and neck, as in blushing—while another emotion should cause the hyperæmia to result in the vessels of the corpora cavernosa—and a third emotion should, similarly, influence the vessels of the salivary glands.

Analogy of local actions of malaria and other poisons in the blood.

The action of the malarial poison, when circulating in the blood, seems quite analogous to the action which strychnia, or ergot, exerts when similarly introduced into the circulatory system; but each poison singles out its own special, local, region for the exertion of its influence.

Strychnia, ergot, or malaria, in the blood, each has a special region of action.

There seem sound reasons for considering that malaria is, essentially, a nervine poison; that, when

Malaria a nervine poison.

introduced into the blood, it exerts its action, locally, on the sympathetic ganglia of the upper digestive viscera, *viz.*: spleen, stomach, duodenum, and liver.

Mode of
production
of local
action of
the poison
of malaria.

This local action probably takes place through the ganglia themselves, without further reference to the general cerebro-spinal nervous system; the stimulus being produced in the ganglionic fibres of the spinal system, and, by them, conveyed to the ganglia; there exerting the inhibitory effect on the sympathetic fibres which withdraws the influence of these latter from the muscles of the bloodvessels—which latter, consequently, undergo relaxation, dilatation, and hyperæmia.

Effect
the same
whether
malaria
acts with
intensity,
or insi-
diously.

The malarial poison seems always to have this effect. When the poison is active and intense, the action is accentuated, and accompanied by paroxysms of fever. When the poison is dilute, and acts feebly, there may be no febrile disturbance recognizable; but the same action on the digestive viscera still goes on insidiously.

Condi-
tion during
the cold
stage of a
paroxysm.

During the cold stage of a febrile paroxysm, intense hyperæmia of the bloodvessels of the digestive organs ensues; and, as these are extremely numerous and capacious, a large portion of the blood of the body is, during the attack, present, distending them.

The other symptoms of the attack seem secondary to this; such as the distressing irritability of the stomach, and the oppression over the epigastrium.

The shrunken, collapsed, bloodless, appearance of the skin, and the spasmodic action of the muscles, known as shivering, seem both due to diminution of their blood-supply, from the excessive amount of blood diverted to the interior ; these symptoms are equally produced by any cause which diminishes the blood-supply of the skin and muscles, such as exposure to severe cold ; ligaturing the main artery of a limb, or prolonged pressure on it, often causes some irregular, intermitting, spasmodic, contraction of the muscles of the part whose blood-supply is thus interfered with. The writer thinks we may regard these symptoms of the skin and muscles as simply secondary to the primary action of the poison on the digestive viscera, not as directly caused by the malarial poison.

When the power of action of the malarial poison on the digestive viscera is exhausted, the hyperœmia of these latter ceases ; reaction takes place, a rush of blood to the tissues of the exterior sets in, causing temporary hyperœmia in them—this constitutes the hot stage. This distention of the cutaneous vessels eventually relieves itself by exaggerated action of the sudatory glands—copious perspiration sets in, the tension of the vessels is diminished, the temperature falls, and an apyretic period follows.

The condition of skin is secondary to the action of the poison on the digestive viscera.

Rationale of the hot stage of a fever.

Rationale of the sweating stage.

CHAPTER V.

PERIODICITY CONSIDERED GENERALLY.

Theory of Periodicity in Malarial Affections.

Periodicity—Considered generally. The term “periodicity”—so commonly employed in defining the characteristic feature of malarial fevers—needs to be used in a restricted, exact, sense, if it is to be of any accurate diagnostic value in the description of fevers of specially malarial origin.

Necessity of restricting the meaning of the term—

Nearly all Pyrexias show it more or less.

Specific fevers

and Symptomatic fevers

quite apart from malaria.

Typhoid closely

On examination, it will be found that in nearly all the diseases, accompanied by pyrexia, to which the human system is liable, this pyrexia has periods—often more or less definite and regular—of exacerbation and of remission. This may be premised, not only of the specific febrile diseases, but also of the pyrexias of local inflammations, such as Pneumonia, Phthisis, &c. ; and in both these classes of diseases, this “periodicity” is an ordinary accompaniment in climates where malaria does not exist, and in cases in which no previous exposure to malaria can be suspected—where, therefore, the influence of malaria is absolutely eliminated, as a cause.

In the pyrexia of true non-malarial Typhoid, the

evening temperature is commonly from two to three degrees higher than that of the morning. The pyrexia of true non-malarial Typhoid often so closely resembles that of true malarial Remittents, that, in India, the diagnosis between these two diseases is frequently extremely difficult, and must be decided almost entirely by other distinctions than the types of their pyrexia. So great is, frequently, the difficulty of accurately demarcating the one disease from the other, that there are still those who consider that there exist sufficient grounds for denying the existence, or occurrence, of Typhoid in India; while others are of opinion that many fevers at present termed "Remittent" are really of the nature of Typhoid, or of Relapsing fever. Most surgeons will have met with cases in which it has been almost impossible to refer the disease with certainty to the one or the other class.

resembles
Remittent
in this res-
pect.

Diagnosis
often diffi-
cult.

Difference
of medical
opinions
from this
resem-
blance.

With reference to the periodicity assumed by the pyrexia of Typhoid, Profr. John Harley notes :—

"One of the most general facts observed in reference to Enteric Fever, is the frequent occurrence of intermittence in the pyrexial condition." (Reynolds' System of Medicine, Vol. I, p. 389.)

"Periodi-
city" in
Typhoid.

DeClaubry notes that the commissioners appointed to investigate the French epidemics of Enteric Fever call attention to the fact that a more or less pernicious intermittent, or at least remittent character, was manifested under a great variety of circum-

Evidence
of De
Claubry.

“stances.” (Mém. de l’Acad. de Méd. tome XIV, p. 71.) “A great number of cases of Typhoid Fever presented, either at the commencement of the disease, transient symptoms of simple intermittent fever, or during its further progress, intermittent or at least remittent phenomena, which rendered the employment of quinine necessary.” (*Ibid*, p. 11.)

Evidence of
Trousseau.

“Enteric Fever may simulate at first intermittent fever, and reciprocally, an intermittent fever may assume at the commencement the characters of Typhoid.” (Trousseau—Clinique Médicale—2nd Edition, p. 247.)

“It is especially in countries where marsh intermittent fevers are endemic, and with individuals who have recently left their own country, that we see Enteric Fever assume at its commencement an intermittent type.” (*Ibid*, p. 250.)

Epidemics
of Typho-
malarious
fever.

There seems no doubt that there occur epidemics of fevers partaking of the nature of Typhoid and of truly malarial Intermittent or Remittent Fever.

This Typho-malarial fever seems chiefly to originate and spread in regions where the poisons of both types of fever co-exist—as in swampy regions in which the soil and water are largely impregnated with decomposing organic matter of both vegetable and animal origin.

Regions of
their
origin.

In ill-drained marshy regions in proximity to human habitations, much animal refuse matter tends

to accumulate and undergo decomposition simultaneously with the vegetable matter of the swamp.

We find that in such regions ague and Typhoid are, ordinarily, both prevalent

In a report by Dr. G. Whitley, as to the amount of ague now prevalent in England (Sixth Report, Privy Council, 1863, p. 432), we find noted that, at Milton, ague was ordinarily prevalent in the autumn, and that there had been a considerable amount of Typhoid Fever at times, while “the drinking water is obtained from wells, and the general sanitary condition, as regards drainage and the non-removal of nuisances, is unsatisfactory.”

Co-existence of ague and typhoid in England.

Holbeach and Long Sutton were noted too for bad drainage and watersupply, and for prevalence of Typhoid and ague. (*Ibid*, p. 441.)

“Very nearly all the medical men who had had opportunities of forming an opinion concerning the co-existence of ague and Typhoid Fever in the same districts, were of opinion that the local conditions which produce the former are favourable to the development of the latter. Thus Mr. Keddell, with forty years’ experience in Sheppey, believed that when ague, from certain conditions of surface, is rife in summer, bilious, remittent, and typhoid fevers prevail in autumn.” (*Ibid*, p. 452.)

Evidence of:—

Professor Harley further observes, that Mr. Charles Mayo reports “that ‘camp fever’ of the army of

Typho-malarious Fever in army of

the Poto-
mac.

“the Potomac was generally recognized as a ‘typho-
“malarious fever,’ in which the symptoms of ty-
“phoid fever, diarrhœa, rose rash, &c., were asso-
“ciated with those of intermittent fever. The
“typhoid symptoms occasionally predominated, and
“*post-mortem* examination revealed lesions of Peyer’s
“glands.”

Nature of
the Wal-
cheren
fever.

Evidence
of cases by
Dr. Davis.

The Walcheren fever seems to have been of a
typho-malarious, or paludal-enteric, nature. Dr.
Davis notes :—“The Walcheren fever assumed the
“quotidian, tertian, double-tertian, and even remit-
“ting type. It did not uniformly declare itself with
“the same type, being one while continued, then
“remittent or intermittent, and changing its type
“again from these to the continued character. I
“believe the Walcheren fever, in many instances,
“would have ceased but for the derangement it had
“occasioned in the abdominal viscera, becoming, in
“some measure, a secondary disease.” (p. 12, *et seq.*)

Many of the cases, too, appear to have been com-
plicated with dysenteric symptoms and lesions. In
at least six of Dr. Davis’s cases there was distinct

Lesions of
solitary
glands.

post-mortem evidence of lesions of the solitary and
agminated glands of the small intestines ; frequently
these lesions extended into the large intestines, and
were there most marked. The liver was, commonly,
large and darkly pigmented ; the spleen, dark,
enormously large (in some cases weighed four
pounds), and often, soft. From a study of the

Do. of
large in-
testine,
liver and
spleen.

symptoms and lesions of the cases of Walcheren fever minutely recorded by Dr. Davis, Professor J. Harley concludes "that the morbid condition of "the solitary and agminated glands of the intestine, Deductions. "in these fatal cases of intermittent fever, is identical with that which is assumed to be characteristic of Enteric Fever. We have already seen that both Ague and typhoid: close relation of. "forms of fever are developed amidst the same "conditions, and we therefore unhesitatingly conclude that Enteric Fever is often a part of intermittent fever, and the converse."

Professor Harley further erects "Paludal-enteric Fever" into a distinct variety of Enteric Fever, Prevalence of paludal-enteric fever. and observes:—"This we believe to be the common "form of the disease. It arises from putrescent "animal and vegetable substances." //

He further proceeds to justify this view by an examination of statistical records of sixty-eight cases Statistics of region of origin. of well developed Enteric Fever, which came under his care during the autumn of 1865. The bulk of these cases came from "the low-lying districts on the banks of the Thames, within and about the metropolis where ague was formerly so rife," and from certain of "the filthiest and most crowded parishes" of London; while only five cases came from the more elevated localities.

He considers the "evidence of the direct connection between these two diseases"—ague and Typhoid Prof. Harley's conclusion. —to be "irresistible."

Certainty
of exist-
ence of
Paludal-
enteric
fever.

The co-existence of the poisons of Typhoid and of true malarial fevers, has thus been frequently and clearly recognized, and the fusion of the two diseases into a distinct type of Paludo-enteric, or Typho-malarious, Fever, has been minutely and accurately described, as having committed fearful ravages during the expedition at Walcheren and among the troops forming the army of the Potomac, and as still prevailing in low-lying, ill-drained, regions in England.

Existence
of Paludal-
enteric
fever in
India.

As the conditions producing the poisons of malarial and of Typhoid fevers obtain, in such a marked and concentrated form, in many parts of India, it is scarcely possible to doubt that these same seeds produce the same diseases in India that they are shown to have produced in other portions of the world. The authoritative assertion that Typhoid does not, and cannot, exist in India seems alike contrary to all analogy and natural laws, and opposed to the experience of observed facts and the recorded convictions of numerous conscientious, highly-educated, and painstaking, medical practitioners in India.

It is probable that many of the anomalous fever-cases, in India, referred by some to the malarial, by some to the Typhoid, type, are, in reality, examples of the Typho-malarious variety of fever.

Value of
term "pe-
riodicity."

Such being the case, it will be conceded that the characteristic of "periodicity" is not one likely to

ordinarily furnish evidence of diagnostic value in the differentiation of the two types of disease.

Few subjects occupy the attention of the medical profession, in India, more prominently, or deservedly, at present, than the necessity of a clear diagnosis of Remittent from Typhoid in this country. It will, therefore, be seen that the term "periodicity" must be understood in a more limited sense than that in which it is apparently often used, if it is to be descriptive of, or specially applicable to, malarial affections—ordinarily so termed.

The diagnosis of Typhoid from Remittent now occupying attention.

"Periodicity" in Typhus.

In the pyrexia of Typhus, too, there is commonly an evening exacerbation, during which the temperature may be from two to three degrees higher than that of the morning.

In Scarlatina, Measles, Variola, Varicella, and Erysipelas, there usually are more or less regularly marked exacerbations of the fever, during the pyretic period of these diseases.

Do. in Scarlatina, Measles, Variola, Varicella, Erysipelas.

In cases of Chronic Farcy, in the human subject, it is noted by Professor Arthur Gamgee, that the disease "is accompanied by fever, which often assumes a tertian type."—(Reynolds' System of Medicine, Vol. I, p. 327.)

Do. in Chronic Farcy.

In *Pyæmia*, too, Dr. Bristowe notes, in speaking of the rigors—"sometimes they occur at short and irregular intervals; sometimes they are quotidian, and resemble, and have been mistaken for, attacks of ague."—(Reynolds' System of Medicine, Vol. I, p. 578.)

Do. in Pyæmia.

"Periodicity" in Relapsing Fever.

The periodical relapses in Relapsing Fever are similarly illustrative of this point.

Do. in Yellow Fever.

In Yellow Fever, too, there are, frequently, evening exacerbations of the pyrexia.

Do. in Dysentery.

In certain varieties of Dysentery, classified by Professor Maclean as Malarious Dysentery, he notes—"Such cases will be recognized by the periodicity of the febrile paroxysms." If this type of Dysentery be regarded as originating from the poison identical with the malarial miasm, it will be no cause of surprise that "periodicity" of its pyrexia should be its distinguishing character.

Do. in Phthisis.

Every one will have noticed how frequent in occurrence are the evening exacerbations of fever in Phthisis.

Do. in Pneumonia and Acute Rheumatism.

In the symptomatic fever accompanying several inflammatory diseases, such as Acute Rheumatism, and even Pneumonia, the same has been observed.

Do. occurs in almost all pyretic conditions of the system.

We are, therefore, justified in concluding, then, that periodical exacerbations and remissions may, with more truth, be said to be phenomena accompanying almost all pyretic conditions of the body, than characteristic of pyrexias of malarial origin.

Do. in Relapsing Fever.

Even periodical recurrences of the subsided disease occur in the certainly non-malarial disease—Relapsing Fever.

Of the fevers due to malaria,

Do. in Malarial Intermittents;

Intermittents are well recognised and demarcated, and, in these, the most certain and characteristic

symptom is the recurrence and subsidence of the disease at intervals so regular and invariable as to admit of these fevers being classified into types—quotidian, tertian, quartan.

In certain secondary affections resulting from malaria, as Hemicrania, and other neuralgias, there is, ^{and in secondary malarial complaints.} also, this marked tendency to periodic recurrence.

In the diseases of residents in malarious regions, a similar tendency is impressed on other affections not of malarial origin.

In the fevers classed as “Remittent” this character of “periodicity” is not so marked, indeed is often ^{In Remittents.} no more so than in many other fevers not of malarial origin.

The question as to the true nature of many of the fevers at present classified as “Remittent” can ^{Probably Typhoid and Relapsing Fever included in the class “Remittent” at present.} scarcely be considered as settled. Probably, many of them are, in reality, cases of Typhoid, or of Relapsing, Fever, and, being therefore of non-malarious origin, cannot be expected to bear the marked characters of malaria. We must await the issue of the present discussion of these points before accepting, as true malarial Remittents, all the fevers at present so classed.

The most characteristic feature, then, of those fevers which are certainly known to be of malarial origin is their almost invariable, periodic, recurrence, or exacerbation, after certain definite intervals of time. ^{Sense in which “periodicity” here used.}

In this sense we use the term "periodicity" as characterising these diseases.

"Periodicity" characteristic of malaria, both in its acute or chronic form.

The malarial poison, moreover, not only causes its fevers to assume this type, but, in a person impregnated with the poison, stamps an impress of periodicity on any affection from which he may suffer while living in malarial regions. During a residence of seven years in one of the most malarious districts of a notably malarious portion of India (Lower Assam), the writer has, daily and almost hourly, had thrust on his attention some fact or feature regarding the action of malaria.

Malaria confers impress of periodicity on most other diseases.

Malaria, in some form or other, underlies, or complicates, most of the complaints prevalent in these regions, and confers, on well-known diseases, tendencies and peculiarities which these diseases have not in other less malarious regions.

In Pneumonia.

Thus, in this miasmatic hotbed, even such a disease as Pneumonia commonly assumes a distinctly periodic form, in its pyrexia; and the writer has, on more than one occasion, seen a distinct Pneumonia returned as ague on account of this impress of periodicity.

Specific fevers.

In most diseases attended with pyrexia, this commonly assumes a periodic type, in its occurrence, in these regions.

All febrile complaints.

Acute Rheumatism.

This is even the case in the premonitory fevers of specific diseases.

Rheumatic Fever, too, frequently assumes a markedly periodic form.

In one case, under the writer's care, the fever of Acute Rheumatism assumed periodicity of a tertian ague form.

Neuralgic pains, of all varieties, are frequently periodic in their invasion. All Neuralgias.

The writer has seen the pains of Dysmenorrhœa take the form of periodicity of a quotidian ague, return at the same time, and last the same number of hours, each day. Dysmenorrhœa.

This peculiar impress of periodicity may be acquired, although the patient may never have suffered from distinct fever of the type of periodicity which is assumed in these various outstanding complaints. This impress of periodicity acquired insidiously.

The impress may be acquired in the same slow, insidious, way, that the malarial cachexia is.

After removal to regions where malaria does not, and cannot, exist, this impress of periodicity still remains, in many cases, to influence the course of other diseases.

This impress of periodicity seems stamped by the poison on the nervous system, and is retained for many years after the poison itself has probably been eradicated from the system by prolonged residence in healthy regions where malaria cannot exist. This impress of periodicity probably never quite lost.

It is believed that this impress of periodicity is never entirely lost.

In this respect, the malarial poison bears a striking analogy to the poisons of some other specific diseases. Analogy between this impress of malaria

and of the
poisons of
the specific
diseases.

In Small-pox, for example, the poison having once thoroughly impregnated the system, leaves an impress on the nervous system for the rest of life, probably, so that the susceptibility of the system to the action of the poison is more or less exhausted.

The protection which vaccination confers against Small-pox poison, and the protection which an attack of Constitutional Syphilis exercises against recurrences, are similar cases of permanent impresses left on the system by specific diseases.

The analogy of these permanent impresses left on the system by specific poisons, and the ineradicable impress of periodicity left by the malarial poison, is very marked, and is another proof that malaria is distinct specific poison.

Reason of
permanence
of these im-
presses not
known.

Why the impress of periodicity, when once set up, should remain after all other symptoms of malaria have long ceased, may be capable of explanation when the phenomena of similar impresses of other specific poisons have been, at some future day, explained.

On the other hand, why the malarial affections primarily assume this form of periodic exacerbation, may admit of some present explanation.

Theory of
periodi-
city.

The writer lays before his readers the following hypothesis which has occurred to him in pondering over the causation of the malarial symptoms and lesions, in this extended sphere of observation of the varied workings of the miasmatic poison.

Theory of periodicity of malarial affections.

Assuming that the malarial poison acts primarily on the nervous system, and, through the sympathetic nerve ganglia, on the involuntary, unstriped, muscular fibres of the vascular systems of the upper digestive viscera, chiefly, we find that the main acute and chronic symptoms produced (*viz.*, ague and gastric irritability, enlargement of the spleen, and cachexia), result from the temporary or permanent dilatation and congestion of the vessels of these digestive viscera, and consequent changes in structure, or exaggerations in function.

Assumption that malaria is nerve poison, explains all its symptoms.

In the cold stage of an ague, the greater portion of the blood of the body is found gorging the spleen and abdominal viscera ; hence the exsanguine condition of the skin and of the muscles, and the consequent spasmodic, irregular, contraction of these latter, or the shivering.

All the symptoms in malarial fevers are explainable.

These symptoms, like those previously mentioned, are doubtless secondary ones, referrible to the primary and main symptom of hyperœmia of the digestive organs from relaxation of the involuntary muscular system throughout their vessels and tissues.

In the spleen, the pale unstriped muscular fibres of the capsule and framework are as much a part of the vascular arrangement as the muscular fibres of the bloodvessels ; they simply regulate the vascular supply of the viscus, and have no other function or action.

In spleen the muscular fibres of the framework are part of the vascular system.

In the stomach the muscular coats are not so.

On the other hand, the unstriped muscular fibres of the coats of the stomach and intestines have special functions, they form a part of the digestive arrangement, and have no immediate connection with the vascular supply.

Hence, though the muscular structure of the spleen framework acts and suffers in unison with the muscular system of its vessels, the muscular coats of the stomach do not, probably, participate in this general affection of its vessels.

On this theory of malaria periodicity admits of explanation.

Moreover, in regarding all the symptoms of malarial fevers as resulting from the poison acting on the nervous system, and, through the sympathetic, on the muscular system of the vascular arrangements of the digestive viscera, and so causing the observed symptoms, we may offer an explanation of the characteristic periodicity of miasmatic affections.

The two varieties of muscular tissue contrasted.

We find that the two kinds of muscular tissue show, in the mode of their contraction under stimulus, marked and characteristic differences.

Action of striped muscle under stimulus.

When a stimulus is applied to any portion of striped muscle, immediate contraction ensues, which again ceases on the instant of withdrawing the irritation.

Action of unstriped muscle.

When any portion of unstriped muscular fibre is irritated, contraction ensues more slowly, and, with alternating relaxation, continues for some time after the withdrawal of the irritation. All the striated muscles are alike in their mode of responding to stimuli.

Among the unstriped muscular tissues there is great difference in the way they respond.

Its action varies in different structures.

Thus, the ureters and gallbladder only act after the stimulus has been applied for a long time, and, even then, act feebly.

Ureter.
Gallbladder.

The contractions of the stomach are quicker ; the alternating contractions and relaxations of the large and small intestines, and of the pregnant uterus, are still more regular and sustained.

Stomach.

Intestines.
Uterus.

The heart, in its rhythmical contraction and dilatation, is the quickest and most vigorous of the unstriped muscles.

Heart.

Thus, the characteristic of the unstriped muscles of organic life is, that, under stimulus, their action consists of alternating contractions and dilatations : and that the muscles of almost each organ show a different period in responding to stimuli ; in the quickness of the alternations of contraction ; in the period during which this contraction under stimulus is continued ; and in the period of negative inertia, or non-response, during which they passively resist the stimulus.

Main characteristic of the muscles of organic life.

The varying periods which the unstriped muscles of different organs show in responding to stimuli, and in undergoing their alternations of contraction and relaxation, may be called the "periodicity" of the muscle.

Periodicity of these muscles.

The symptoms constituting the fever in malarial poisoning are assumed to be produced through an inhibitory action on the sympathetic nerves governing

Mode of causation of fever.

the muscular fibres of the vascular system of the digestive organs, and especially of the spleen, and by the consequent periodical fits of relaxation of these muscular fibres and distention of the vessels.

Rationale
of periods
of pyrexia,

and of
periods of
apyrexia.

These periodical fits of atonic laxity of the muscular fibres of the vascular system, constitute the periodical periods of malarial exacerbations ; while the periods intervening, during which these muscular fibres passively resist the influence of the malarial stimulus to their nervous ganglia, constitute the periods of apyrexia.

Periodicity
of the mus-
cles of the
bloodves-
sels.

These periods may be defined as the “periodicity” of these muscular fibres ; or the periods of alternations of action under stimulus, and of negative resistance to stimulus ; the stimulus being the influence of the malarial poison on the spinal nerve fibres which are antagonistic or inhibitory of the influence of the sympathetic fibres, of ganglia, on the muscular fibres of the vessels and vascular arrangements of the digestive viscera and spleen.

Action of
heart
rapidly
alternat-
ing.

The unstriped muscular fibres of the heart, under nerve stimulus, alternately respond by contraction, and by passive relaxation from non-response.

Action of
stomach
and intes-
tines more
slowly
alternat-
ing.

The stomach and intestines, under the stimulus of the sympathetic ganglia, alternately act by contraction, and remain passively lax from non-response to the stimulus, the periods of negative resistance between the times of responsive contraction being much more prolonged than in the case of the heart.

The gallbladder, or ureter, under a similar stimulus, acts very slowly. Under a stimulus of electricity, each has a prolonged period of passive laxity ; eventually, contraction ensues and lasts a long time ; and when laxity has again set in, the muscular fibres again experience a long period of passive inertia in again responding to a new stimulus. These are admitted physiological facts.

Action of the same muscle under different stimuli.

Not only does the period of negative laxity, between consecutive periods of active response, vary widely in the similar unstriated muscle of different regions and organs, but the same set of fibres varies greatly, in the duration of these periods of negative inertia and active response, according to the nature and degree of the stimulus.

The same fibres vary widely in their action according to the nature of the stimulus.

Thus the gallbladder, or ureter, under stimulus of cold water, has a very prolonged period of negative inertia, and a short period of active contraction ; under the stimulus of mechanical irritation (from drawing a pin across it), the negative period of resistance is shorter, and the active contraction more lasting ; while, under the influence of electricity, the periods vary according to the intensity of the shock, the more intense the shock, the shorter is the period of passive enertia, and the more prolonged the active contraction ; and the converse.

Gallbladder or ureter under different stimuli.

Thus, we see that unstriated muscular fibres, in different regions, though apparently identical in structure, have very different powers of resistance,

Characters of unstriated muscle.

or response, to continued stimuli ; and that the same fibres behave very differently under the same kind of stimulus according to the intensity of this stimulus.

So it is in the action of the malarial poison.

Intense
stimulus of
concentra-
ted malaria
causes
quotidian
ague, daily
pyrexia.

In the case of the marked stimulus of the poison in an intense and active form, the muscular fibres of the vessels have a shorter period of negative inertia, and a more prolonged period of active response ; that is, the period of apyrexia is short, and the paroxysm of pyrexia prolonged, constituting the quotidian type of ague—the paroxysm occurring once in 24 hours.

Professor Maclean notes—“ The presence of a quoti-
“ dian seems to indicate a high degree of saturation,
“ requiring a more frequently renewed effort of nature,
“ for, at least, its partial elimination, than either a
“ tertian or a quartan.”

Milder
stimulus of
dilute
malaria
causes
pyrexia
only once
in 48 or 72
hours.

In the case of the malarial poison being less intense-
ly concentrated and active, the less powerful stimulus
on the nerve ganglia produces its effects of active res-
ponse of the unstriped muscular fibres of the digestive
vascular system, only after a more prolonged period
of negative inertia ; and the paroxysm of fever only
occurs once in 48 hours, or in 72 hours.

The period of continuance of the active response of
the muscular fibres, too, is less prolonged in these
cases, than in the case of the more powerful stimulus
of the concentrated poison producing a quotidian.

In a
quotidian
pyrexia
prolonged ;

Professor Maclean notes—“ The duration of the
“ paroxysm of intermittent fever varies with the type.

“It is longest in the quotidian, which lasts from 8 to 10 or 12 hours ; the tertian lasts from 6 to 8 ; the quartan lasts from 4 to 6 hours.”

Again, in the same fever, when the disease is waxing, the cold stage paroxysm will appear earlier, and the apyrectic period will get shorter ; while, when the disease is “waning,” from the process of elimination of the poison having advanced, the cold stage paroxysms will arrive later, be postponed for an hour or two, and the apyrectic interval will become longer.

Thus, we again see that the stimulus of a more concentrated poison, even in the same fever, will act in a more powerful manner on the nerve fibres of the sympathetic ganglia, and the action of these last, on the muscular fibres of the digestive vascular system, will be marked by a shorter period of negative inertia ; while, after elimination of some portion of the poison, the converse will hold good.

The action of the unstripped muscular fibres of the digestive vascular system under the varying stimulus of the malarial poison, seems exactly analogous to the behaviour of the similar unstripped muscular fibres of the gallbladder, or ureter, as above noted, under the continued stimulus of electricity, this stimulus, also, varying in intensity. And it is probable that, during the apyrectic period of negative inertia, the malarial poison not only acts continuously but with a constantly augmenting intensity ; and, probably, after the pyrectic period, much of the intensity of the poison

apyrectic period short.
Waxing or “waning” of fever.
Rationale of the above.
Analogy of behaviour under malarial & other stimuli.
Malaria is a constantly acting poison. Eliminated partly at each

pyretic
period.

has been destroyed, so that it again acts feebly, till it accumulates intensity enough to produce, by its continued action and its climax of concentration, a new period of pyrexia. Thus Maclean speaks of the "at least, partial elimination" of the malarial poison at each fever paroxysm.

After py-
retic
period the
malarial
poison is
destroyed
and its
stimulus
ceases.

There is little doubt that the malarial poison is eliminated, or destroyed, during the period of pyrexia of an ague, and during the free action of the skin, which usually puts a period to the paroxysm. Medicines of an "eliminative" nature, that is, such as act on the excretory organs—the skin, kidneys, bowels—and increase their action, are believed to assist in carrying the poison out of the system. After the pyretic period, then, the malarial poison is for the time eliminated; its action is exhausted; the stimulus is withdrawn;

This is
apyretic
period.

and the muscular fibres of the visceral vessels are no further acted on: this is the apyretic period. The state of the vessels, now, is just that of the ureter while the stimulus of electricity is withdrawn. As the ma-

The
poison
accumu-
lates and
again is
intense
enough to
act as sti-
mus.

larial poison again accumulates, and elimination is checked, it attains the degree of concentration which again renders it a sufficient stimulus to again act on the muscles of the vessels, and their nerves, and the pyretic period follows. This state is analogous to

As electric
stimulus
again to
ureter.

that of the ureter, when the electric stimulus is again applied and contraction ensues. There is a marked

Rationale
of the great
variations

difference in the period of negative inaction—24 or 48 hours—of the unstriped muscular fibres of the

vascular system of the digestive organs under the continued stimulus of the malarial poison, and the longest period of negative inaction of the gallbladder, or ureter, under continued stimuli.

This is, however, a matter of degree only, not of kind.

And the degree of observed difference between the periods of passive non-response to stimuli, in the heart, and in the ureter, is almost as marked. In an infant, the heart responds to nerve stimulus, by alternations of contraction and laxity, from 120 to 130 times in a minute; while the ureter, under even the stimulus of electricity, does not act till the stimulus has been applied for some minutes; thus, if we say it acts after three minutes of continuous application of the stimulus, these muscular fibres act nearly 400 times more slowly than the similar muscular fibres of the heart.

We may, then, allow wide limits of variation in the periods of negative inaction on stimulus.

Again, we have seen that the same set of unstripped muscular fibres have very varying lengths of the period of negative inertia on stimulus—according to the feeble or powerful nature of that stimulus.

We have seen that the stimulus of cold was much less rapid and persistent in its effect on the ureter than the stimulus of electricity.

On this ground, too, we must leave a wide margin of allowance for the great difference in the length of

in the periods of non-response.

Great difference in the rapidity of action of different regions of unstripped muscle.

Similar variation of the same muscles under different degrees of stimulus.

Comparison of the malarial poison with

electricity
as a sti-
mulus.

the periods of passive inertia of the muscles of the vascular system of the digestive organs under a stimulus of such undetermined value as the malarial poison, and the period of inertia, in even the slow-acting ureter, under such a widely different stimulus as electricity.

Compare
ague with
specific
diseases
with re-
gard to
length of
apyrectic
or incuba-
tive period.

We have no knowledge of the relative value of the intensity of the stimuli, in comparing the malarial poison with such a definite stimulus as electricity.

But when we compare the rapidity of action of the malarial poison with that of other specific poisons, we find that its action is in many cases even more rapid.

There is a striking analogy between a single apyrectic period and paroxysm, in an intermittent fever, and the period of incubation and the development of the febrile symptoms in many specific diseases.

Great
similarity
found.

Thus we find that when the poison of these latter diseases has entered and laid hold of the body, yet a certain period of resistance, as it were, is manifested before the system succumbs to the attack,—much as the malarial poison lies inactive for the apyrectic period, and then manifests itself during the febrile paroxysm.

We find that the periods of negative inertia, or incubation, of certain specific diseases, after the system has received their poison, to be not much longer in interval than the apyrectic periods of the several types of intermittent. Thus :—

In *varicella*—the period of incubation is 3 or 4 days.

In *Erysipelas*—from 3, to 7, days.

In *Scarlatina*—from 2, to 6, days.

While the recurring incubative, or apyretic, period, in agues, is—

in quartan 3 days (72 hours).

in tertian 2 days (48 hours).

It seems possible that identity of mode of causation may be established between the processes of incubation of the poisons of specific diseases, and the interval of apyrexia in intermittents.

APPENDIX TO PART I.

Isolation and Identification of the Malarial Poison.

Since these sheets were sent to the press, two Roman *savants*—Professors Klebs and Tommasi—have given to the world the results of their investigations on the form in which malaria exists. They claim to have isolated and identified the material poison of malaria.

In the lower strata of the atmosphere over the intensely malarious Campagna, and in the soil of that region, they discovered a certain microphyte resembling long, oval, fungoid bodies, about nine micro-millemètres in diameter.

It is reported that the existence of this microphyte has been detected in the blood of persons suffering from malarious fever; and, further, that the microphyte, when introduced, by inoculation, into the blood of a healthy person, is capable of setting up a paroxysm of true ague.

It is, moreover, alleged, that inoculation with this microphyte (for which the discoverers have suggested the name—*Bacillus malarie*) produces, in the lower animals, that typical enlargement of the spleen which is so characteristic a lesion of chronic malarial poisoning in the human organism.

Should more extended researches confirm these propositions, it will have been conclusively demonstrated—as it has, for a long time, been suspected—that the material and active element of the malarial poison is a lowly-organised, fungoid, cell-form.

PART II.



INJURIES OF THE SPLEEN: AN ANALYSIS OF
39 CASES.

PART II.

INJURIES OF THE SPLEEN: AN ANALYSIS OF 39 CASES.

CHAPTER I.

GENERAL REMARKS.

The Spleen in Health and Disease.

FROM the frequency of their occurrence, and the importance of their medico-legal bearings, injuries of the spleen are of peculiar interest to the medical practitioner in India, who may be called on, at any time, to furnish in the Courts of law a technical, skilled, interpretation of the *post mortem* evidences of such injury.

The injuries themselves are of very frequent occurrence, and, often, there arise, in the Police Courts, questions as to the period of possible survival, and capability of performing certain acts, or of going through certain amounts of exertion, in the interval between the injury and death.

Of great medical interest, too, is the question of possibility of recovery from bruises and ruptures of the spleen.

Formation
of sound
opinion on
cases.

Sound logical opinions on these subjects are to be arrived at only by careful physiological consideration of the nature of these injuries, and by a close study of the accumulated experiences of observed facts through an extended series of cases.

Value of
records of
cases.

The records of all observed cases are of value as tending to swell up the literature of the subject and that accumulation of facts whose eventual outcome is intelligent, logical, opinion.

These re-
cords are
of cases
which
have occur-
red in this
district.

The desire to add his item to the already existing pile of recorded facts has induced the writer to collect and publish the details of thirty-nine cases in which injuries of the spleen have come under observation at this station. Of these thirty-nine cases, seventeen were recorded by his predecessors ; twenty-two have occurred in the writer's own practice.

Malarial
regions
chiefly fur-
nish these
cases.

The malarial regions of India appear to furnish these cases in much greater proportion than the non-malarial ones, and, in respect of intensity of malaria, Lower Assam is, probably, second to no region of India.

Irregular
distribu-
tion of
cases.

Of thirty-eight cases of rupture of the spleen cited in Norman Chevers's "Medical Jurisprudence in India" (3rd edition of 1870), we notice that seven were recorded in one year, by Dr. K. McLeod, in the malarial region of Jessore. On the other hand, as illustrating the irregular distribution of these cases, we notice that Prof. Norman Chevers (in the same edition, page 457) records that he has met with only three such cases in his own practice in India.

The present papers are founded on the thirty-nine cases of injury to the spleen which have come under observation (the writer's predecessors', or his own) in the district of Kamroop, Assam,—a region peculiarly fertile in these injuries. Most of them were cases sent in by the Police, for examination.

Cases on which the present papers founded.

Region of their occurrence.

The deductions drawn, and conclusions arrived at, are founded on these cases alone. The writer's desire is merely to lay before his readers the facts and teachings of these hitherto unpublished cases, leaving it to other more able pens to amalgamate them with previously published records, and to distil out the practical teachings of the whole.

Scope of present papers.

Whatever weight may attach to the deductions which the writer has drawn from the facts of these cases, he trusts that the facts themselves may help to contribute to the literature of the subject.

Value of the facts apart from deductions.

To facilitate a systematic handling of the subject, the writer has divided the cases into three classes, founded on the intrinsic difference of the injuries.

Plan of the present papers.

He has followed the plan of analysing and discussing the cases, in detail, under each head, from a separate point of view. This plan necessarily involves much repetition of detail under different heads ; the same detail may, indeed, appear under each separate heading, but, in every instance, in illustration of a different point of view of the subject.

Full details under each head.

Repetition inevitable.

The information under each individual head stands as a distinct and, in itself, complete consideration of

But each head more complete in itself,

the cases of injury from its own point of view, quite independent of that contained under other heads.

and more
handy for
reference.

The writer thinks that this system has the advantage of rendering the information more individually complete and handy for reference, in case it is required to refer with regard to the statistics or bearings of these cases from any one point of view. He has, therefore, adhered to this plan, at considerable increase of labour, and at the risk of being charged with redundancy.

Details not
complete in
some cases.

It is a matter of regret that the records of certain of these cases are not complete as to each detail, and this renders some of the tables far from being as full and comprehensive as they otherwise might have been. In several cases, the condition of the stomach, as regards distention or emptiness, is not entered in the records; and, hence, Table IV, on this subject, is not as complete as could be desired.

Hence
some tables
incomplete.

Notes on the Spleen in Health and in Disease.

Spleen in
health;
position
and
defence.

In a state of health, the spleen should be small and firm, and should entirely lie beneath (behind) the left lower ribs. In this state, the spleen is well defended and little liable to injury.

Capability
of the
healthy
spleen to
resist
injury.

The writer has, later on, detailed a case showing the amount of violence a healthy spleen can bear without injury. The man (Case No. 38) fell from a height on to his left side; there was very severe bruising of the tissues of the left side of abdomen;

the stomach, distended with a large meal of rice, was brought into violent contact with the spleen; but, as the spleen was normal and firm, it entirely escaped rupture, though the shock ruptured the stomach, in two places, where its coats were taken between the mass of rice on the inside and the firm spleen on the outside.

Details of illustrative case.

The spleen, besides performing special functions, acts as a diverticulum for the blood of the abdominal vessels. It, ordinarily, enlarges after a meal, towards the end of digestion.

Spleen a diverticulum.

Quain (Anatomy) notes that no organ varies so much in size in different individuals, or, in the same individual, under different conditions. In malarial fevers, it becomes for a time distended and enlarged, and, from a repetition of these fevers, or from constant residence in malarial regions, it becomes permanently enlarged, forming the well known "ague-cake."

Spleen varies much and constantly in size.

In the normal state, it weighs from 5 to 7 ounces; it has attained a weight of 40 pounds; it has been found weighing only two drams. In malarial fevers it may reach 18 to 20 pounds (Quain).

Normal weight.

Maximum weight.

In malarious regions, where fevers abound, enlargements of the spleen are of more or less universal prevalence. In the marshy regions of Lower Assam, malarial fevers, and the depraved state of health, from slow malarial poisoning, known as malarial cachexia, are almost universal among the natives;

Malarial enlargement of spleen.

Ditto almost universal in Lower Assam.

and, consequently, spleens in every stage of enlargement are met with, from the moderately enlarged organ just descending below the ribs, to the vast bag of blood extending to the pubes and capable of being ruptured by the slightest injury.

Changes in
consistency.

The spleen, in enlarging, undergoes, also, changes in structure and consistency.

It, most commonly, becomes softened and pulpy, and, occasionally, attains an almost diffluent condition—being, in point of fact, a “mere bag of blood.”

These changes, no doubt, result from the relatively great increase in the amount of true spleen pulp, as compared with the fibrous framework of the viscus ; and, in cases of extreme softening, fluid congestive exudations from the gorged vessels are present in the true spleen tissue.

The soft,
large
spleen.

This is the typical, soft, enlarged spleen. Sometimes, however, the spleen, in enlarging, acquires the consistency of an imperfectly coagulated clot of blood, somewhat firm superficially, but friable, brittle, and easily broken down.

The enlarged
friable
spleen.

This condition seems to result from exudations of semi-organisable lymph having taken place, from the congested splenic vessels, into the spleen pulp, and, there, having undergone imperfect coagulation, caking together the elements of the spleen pulp. This is the friable enlarged spleen.

Capsule in
health.

The capsule of the spleen, in the normal state, is thin and translucent. From chronic inflammatory

changes, inducing these permanent enlargements of the spleen, the capsule usually becomes opaque and thickened. The writer has seen it, in several cases, thickened into a tough, opaque, covering closely resembling chamois leather. Such a capsule, enclosing a soft, large, spleen, may remain intact after an injury which has ruptured the soft tissue of the contained spleen. Case No. 35 illustrates this—*(vide* Chapter III, Class II). Much support and protection is afforded to the spleen by such a capsule.

Changes in capsule in disease.

Thickening sometimes extreme.

Giving much support and protection.

Surroundings of the Spleen.

The spleen is surrounded, on most sides, by more or less rigid, resisting, bodies :—above, the diaphragm, rendered tense during inspiration ; behind, by the left kidney, and (in the enlarged state) by the spinal column ; on its inner side, by the stomach, distended at intervals, by masses of food, into a body as hard and resisting as a cannon ball.

Surroundings in health

limited on every side except lower.

When, therefore, the spleen undergoes any great enlargement, the only direction in which it can freely extend is downwards into the abdomen. In doing so, it leaves the protection of the ribs, and is, in front, only sheltered by the muscular walls of the abdomen, themselves, in such cases, often much thinned and weakened from malarial cachexia. This softened spleen, only protected by the abdominal walls, is very liable to direct rupture, on the application of any violence.

Direction of spleen enlargement.

Hence
liable to
injury.

It is, moreover, liable to be driven, by any violence, against some of its harder surroundings, and thus ruptured against the kidney, the spine, or the hard distended stomach.

Distention
of stomach.

The Assamese are a rice-eating race, and, as the poorer classes eat only once, or at the most twice, a day, it is essential, in order that they may get sufficient nourishment out of this farinaceous food, that they should take large quantities at a time. Their almost universal custom is to gorge two full pounds of rice at a sitting. The stomach is thus, for a time, distended into a more or less solid, dense, inelastic, body. If a man with enlarged, softened, spleen, and with stomach in this condition, meet with a fall, or other violence, what chance of escape is there for the softened spleen taken between the concussing body in the outside, and the unyielding stomach, hard as a cannon-ball, on the inner side? It is much in the condition of an orange placed between a smith's hammer and anvil.

Stomach
swollen and
hard is a
dangerous
neighbour
to a large
soft spleen.

As a matter of fact, it does not, ordinarily, escape, but is often shattered by many ruptures, or nearly split in two. In four cases, of the thirty-nine herein discussed, the enlarged, soft, spleen was more or less split in two.

Conditions
determin-
ing nature
of injury
to spleen.

The conditions determining the nature of the injury which the spleen may sustain are discussed further on, in later chapters.

Roughly speaking, they are : (1) the degree and

nature of the violence; (2) the condition of the spleen, as regards size, softness, and exposure; and (3) the degree of hardness and inelasticity of the bodies in contact with the spleen, notably the stomach.

If an enlarged, soft, spleen be forced inwards, by any violence, (especially slow acting violence), it may be readily conceived that, were the spleen to meet with only an elastic, yielding, empty, stomach internally, it might escape rupture; whereas had it been in close contact internally with a hard, unyielding, full, stomach, either stomach or spleen would tend to rupture; as a matter of fact, the spleen generally suffers, in such cases, if it be enlarged and either softened or friable, as abundantly proved by the cases under review.

The writer has, however, seen a case (No. 38) in which, in similar circumstances, a healthy spleen suffered only a bruise, while it inflicted on the stomach a double rupture at the region of contact.

On the other hand, if the enlarged, softened, spleen, protected only by the abdominal muscles, receive injury by a sharp blow with a non-massive body, such as the hand or a stick, direct rupture may occur on that portion of the viscus which receives the first concussion, *viz.*, the convex surface or anterior margin, or it may occur on the deep surface (concave), by contre-coup.

In all the above instances, the rupture may be through capsule and spleen tissue, at the time of

Condition of stomach determines nature of injury to spleen.

A healthy spleen may escape.

Enlarged spleen below ribs; direct rupture by a sharp blow or by contre-coup.

Definition of Class III cases.

injury. Cases in which the rupture is so, the writer has grouped under Class III.

Definition
of Class II
cases.

Under any of the above described conditions, if the enlarged, soft, spleen be enclosed in a capsule inordinately thickened into a tough covering like chamois leather (as in Case No. 35, Class II), the soft, or friable, spleen tissue may suffer rupture inside, while the containing capsule remains entire, like a crumbled pudding inside its entire bag, to use a homely comparison. Such cases the writer has placed in Class II.

Definition
of Class I
cases.

Under certain conditions, if the violence be not overpoweringly severe, and the spleen be not far departed from a healthy standard as regards firmness and elasticity, the injury may assume the form of bruise only, the spleen not suffering rupture in either capsule or tissue. Such cases the writer has grouped under Class I.

Why in
Lower
Assam ma-
larial af-
fections
abound.

It will scarcely be surprising that malarial enlargements of the spleen are so universal, and injuries of the spleen so common, in this district (Kamrup), if the physical conditions and climate of the region be considered. A very large proportion of the district consists of marshes and grass jungle. The marshes encroach vastly on the contiguous low lands, in the rains, and, contracting during the dry season, leave vast areas, covered with organic matter, seething in the sun.

Physical
characters.

The grass jungle is, in height, in density, and in

extent, unsurpassed, probably, by any in India ; it is from 20 to 25 feet high, aptly named “elephant Marsh-grass”—(Col. F. Pollock’s “*Sport in Burmah and Assam*”). It is the habitat of the rhinoceros and buffalo, who lie wallowing in its almost impenetrable swampy recesses ; in it live, also, herds of wild elephants and bison.

These jungles have earned a wide and well-deserved renown as preserves for large game shooting.

The cultivated low grounds consist of alluvial deposit, richly impregnated with organic matter of vegetable origin. Beneath this alluvial surface soil, lie beds of stiff yellow clay, which are more or less impervious to water, and thus keep it close up to the surface.

Consequently, in regions where the water does not lie permanently on the surface in the form of marshes, the subsoil water level oscillates to and fro, but always close to the surface of the ground.

When the hand of man is withdrawn from any portion of this land, it rapidly becomes covered with rank, luxuriant, vegetation, alternately dying down, and again, phoenix-like, springing into vigorous life from the decaying hotbeds formed by the debris of numerous previous crops, collapsed, and decomposing *in situ*.

The climate is intensely humid ; the air is close upon saturation with aqueous vapour, especially during the hottest months of the year. The clear, dry, heat of the North-West is here unknown.

Wells are never met with.

Villagers
live near
marshes,

The bulk of the villagers live on the banks of the marshes and the higher ground contiguous to them, or on the banks of small streams running out of the marshes. Marsh water lies at their doors, and is the most convenient and accessible, if not the only, source of supply. Hence, water, saturated with malaria, and taken from the marshes, either directly, or through the intervention of these small streams coming from the swamps, is the almost universal source of supply for the domestic uses of the inhabitants.

and use
marsh
water for
drinking.

Lower
Assam fer-
tile in en-
largements
and rup-
tures of the
spleen.

Thus we have all the factors of malaria existing in a great degree of intensity ; and it need cause no surprise that enlargements of the spleen are almost universal ; and, hence, ruptures of this diseased viscus are far from uncommon. Probably, Lower Assam affords an almost unrivalled field for the study of Injuries of the Spleen, and of Malarial Affections of that organ.

CHAPTER II.

CLASSIFICATION OF INJURIES OF SPLEEN.

Class I.—BRUISES OF SPLEEN.

Classification of Injuries of the Spleen.

For convenience of methodical description of these cases of injury to the spleen, the writer will group them into three classes.

Class I.—Cases in which the spleen tissue is bruised, not ruptured. Four cases fall into this class. Definition of classes.

Class II.—Cases in which the spleen tissue has suffered rupture, the capsule remaining intact at the time of the injury. One case falls into this class.

Class III.—Cases in which spleen tissue and capsule are both ruptured at the time of the injury. Thirty-four cases fall into this class.

These three classes are marked out, the one from the other, by radical and essential differences in the nature of the injury, and by consequent differences in the period of survival and possibility of recovery.

The division seems, therefore, a natural and useful one.

Class I. *Class I.*—Cases in which the spleen tissue is bruised, not ruptured.

General Causation.

Mode of
causation
and region
of injury.

When any violence is applied to the region of the spleen, if that viscus be not much enlarged and be tolerably firm of substance, it may escape rupture, and merely suffer bruise. This seems the more likely to occur if the violence be of a slow, continuous, kneading, nature, not overpowering, and if the stomach be empty, and so present an elastic, yielding, instead of a hard, resisting, body, internally. In such a case, we might expect to find a bruise on the external surface of the spleen; or, were that viscus compressed, without crushing violence, between the external force and a distended stomach, we might expect to find the bruise on the concave surface, or on both surfaces.

Of four
cases three
were from
pounding,

one from
fall.

Thus we find that of four of the cases of Bruise of the Spleen, herein noted, three were caused by pounding with the feet, knees, and elbows, of assailants. One was caused by a fall from a tree on to the left side; the stomach was distended at the time, and, against it, the firm spleen was bruised on its gastric (concave) surface.

Spleen firm,
in three.

Of these four cases, in three the spleen was firm, and either normal, or only slightly enlarged, in size.

Details of Cases.

A. Three caused by pounding—

Cases of
Bruise of

Two, *viz.* cases Nos. 33 and 34, came under observa-

tion immediately after the accident ; one, No. 37, was spleen caused by pounding.
only examined some time after, by dissection.

B. One case, caused by fall, was not seen during Do. by fall.
life, but was dissected as a Police case.

A. Case 33—Fatal bruising of the spleen. *Narah* Cases by pounding.
Koiburto, a Hindoo male, *æt.* 30, was sent to hospital, Case 33, Fatal bruising.
by the Police, on 21st February, 1879. He was
reported to have been injured on the 20th.

He describes himself as having been thrown down,
and pounded about the chest and abdomen by the
feet, knees, and elbows, of three assailants. On ad-
mission, no swelling, or marks of bruise, discoverable
on any portion of the surface of body, though his
skin was not darker colored than coffee.

He was able to get out of the dhoolie and
walk into hospital. He complained of great pain Pain.
over left side of chest and abdomen ; digital examina- Tenderness
tion caused much pain ; exhaustion not marked,
though pulse was quick and feeble. There was Fæcal diar-
diarrhœa, and vomiting of bile-tinged mucus. The rhœa. Vomiting.
lower edge of the spleen could be felt just below the
margins of the left lower ribs. The left lung, to- Lung
wards its base, was dull on percussion, and respira- symptoms.
tory sounds were obscure, but no crepitation audible
during the first day. During the next two days, the
temperature was constantly about 3° above normal ; Tempera-
the diarrhœa and vomiting subsided ; milk and soup ture.
were retained. The area of dulness over the left Increasing lung con-
lung steadily increased, till, on the third day, it ex- gestion.

Death on
fourth day.

tended over the whole lung, and moist crepitation was everywhere audible over this lung; the breathing sounds were faint. Death occurred on the evening of the 24th, *i. e.*, four days after the injury. There was no peritonitis, at any time.

Post mor-
tem exami-
nation.

In this case, the symptoms pointed to some irritation of the intestines in the first instance, and to some injury to the left lung, causing increasing congestion. But what symptom definitely indicated that the spleen had suffered? Yet we find, on dissection, that a severe bruise of that viscus existed.

No marks
of bruising
in skin or
muscles.

Post mortem, 10 hours after death, showed that no marks of bruising existed in the skin or muscles of the left side or any other region of the body. The

Spleen firm

spleen was firm, and but slightly enlarged. On its

A patch of
ecchymosis
on its con-
vex sur-
face.

convex surface, where it had been in contact with the abdominal wall, a patch of dark-purple ecchymosis was found, 3 inches long, 2 inches wide, and extending from one-third to half an inch into the spleen substance; its dark color contrasted strongly with the lighter, reddish-brown, color of the rest of spleen sub-

Lung brui-
sed and
congested.

stance. The left lung was severely congested, over the surface in contact with chest wall. Towards the base, the anterior surface of this lung was pink, from ecchymosis.

Right lung, healthy; stomach, empty.

In this case, the stomach was empty at the time of injury. The concave surface of the spleen escaped injury. From the fact that the left lung showed

pink marks of severe ecchymosis, and suffered from increasing congestion, while the right lung remained healthy, it is clear that the congestion was not merely a secondary result of the man dying from exhaustion.

The main symptoms were those of the lung injury, which was, evidently, the chief cause of death.

Main cause of death ; the lung injury.

It is to be noted in this case, as it will be repeatedly noticed in other cases, that the injury to the spleen did not, in itself, cause any marked, special, symptoms, nor was that viscus tumefied, or inflamed, or generally altered, by the injury, in any region beyond the discolored patch of bruise on the convex surface.

Spleen injury caused no special symptoms.

Case 34. Bruise of spleen. Recovery. *Mohiram*, a Hindoo, *æt.* 39, was sent to hospital, by the Police, on 29th March, 1879, reported to have been injured in a quarrel, on the previous evening. He reports that he was thrown down, and pounded by the knees and feet of assailants. On admission, he complained of severe pain over left side of abdomen, in the region of the spleen. On digital examination, which caused much increase of pain, the edge of a firm spleen could be felt just below the line of the left lower ribs. No definite sign of bruise could be discovered on the skin; the man was, however, of dark complexion. The skin was tumefied over left lower ribs. The pulse was feeble and quick; skin rather cold; there was considerable exhaustion. There was some fæcal diarrhœa, but no

Case 34.
Bruise of spleen.
Recovery.
Mode of injury.

Local pain and tenderness.

Spleen can be felt.

No bruise on skin.

Condition of pulse and skin.

Diarrhœa.

vomiting ; the abdomen was soft, and deep pressure caused no pain, except over spleen. At no period was there any sign of peritonitis, showing that, probably, no internal bleeding had taken place, and, consequently, that there was no rupture of spleen. There was no sign of lung mischief ; percussion, and the stethoscope, showed both lungs healthy.

No peritonitis.

Spleen not ruptured.

No lung injury.

Temperature.

Pain and tenderness over spleen continued.

Throughout the next week, his temperature was, constantly, about 2° above normal. He continued to complain of severe pain over the region of the spleen ; deep pressure over this region caused faintness and sickness.

The exhaustion continued. There was, however, an absence of prominent symptoms.

Discharged after eighteen days.

He left hospital, on 16th April, *i. e.*, eighteen days after the injury, and soon regained perfect health.

It is to be noted that the diagnosis of this case has not, up to the present, been confirmed by dissection.

The absence of prominent symptoms, and the recovery, are probably attributable to there being no injury to the lungs, or to any other viscera besides the spleen.

Case 37,
Bruise of spleen.

Case 37. Bruise of spleen—recovered from. Marks of injury found on the spleen, on dissection, some time afterwards.

Injury

Simbi Garo, male, *æt.* 40, was injured by pounding with feet, knees, and elbows, of several assailants, in June, 1876.

He suffered from severe pain over the region of the spleen, and was ill for twenty days afterwards. During the first two days, there was some purging and vomiting ; there was great exhaustion, for many days. One of his assailants, Bali Ram, furnishes this history.

Ill for twenty days.
Symptoms.
Local pain.
Purging.
Vomiting.

The man died, of diarrhœa, on 20th August, 1879. On dissecting the body, marks of old injury were found on the spleen. That viscus was firm, and normal in size ; on its convex (outer) surface, were two

Death three years after.

Marks of injury on spleen.

white patches, irregular in outline ; one, about two inches across, the other, about one inch ; over these patches, the capsule of the spleen was dense, white, leather-like ; the patches penetrated about one-fifth of an inch into spleen substance. On their surface, they were somewhat puckered. They were divided, by a sharp line of demarcation, from the rest of spleen capsule, whose glistening, semi-transparent, appearance strongly contrasted with the rough, puckered, white patches. No signs of injury on any other viscera.

White patches involving capsule and spleen tissue.

In this case, the man did not come under skilled observation at the period of injury, but the history of the assault and consequent pain and illness is complete.

Comments on the above case.

The writer thinks there is little doubt that these marks, found on the spleen, were the contracted fibrinous exudations resulting from the localised inflammation following a bruise.

It will be noticed that in Cases Nos. 33 and 38 (below), the spleen, though it showed, on dissection,

Spleen showing localised bruise, but

no general inflammation of the viscus. a local bruise, in neither case showed any general inflammation of the viscus ; the bruised part was local-

ised, and distinctly and sharply limited to this region.

Color of the recent bruises. The ancient bruise decolorised into white organised lymph.

The appearances found, in those two cases, on the spleen, on dissection, closely resembled those found in the present Case (No. 37), except that the recent bruises were of a bright pink, or of a dark purple color, according as they were seven hours (Case 38), or four days (Case 33) old, while in the present case (No. 37), as three years had elapsed since the injury, the effusion at the bruise was decolorised, and only the white mass of organised fibrinous tissue remained.

Not gummata.

These white patches in no way resembled the gummata (probably from tertiary syphilis) sometimes found in the spleen.

Case by fall.

B. Bruises of the spleen, by fall from a height.

Case 38. Fall on left side.

Case 38, *Shombaroo Sheikh*, æt. 19—on 29th August, 1879, fell from a bamboo platform, 8 feet 3 inches high ; his left side struck the ground, the left side of abdomen, about the level of the umbilicus, impinging on a blunt bamboo stump in the ground. The fall occurred at 3 A. M. ; he died at 11 A. M., seven hours after the injury, and the body was sent in for examination. He is reported to have been conscious for some hours, and to have suffered from collapse.

Death in seven hours.

Death by exhaustion.

Superficial wound.

There is a superficial wound, 3 inches by 2 inches, on left side of abdomen, about the level of umbilicus, and, in the muscles beneath and round this, there is much effused blood.

Severe external bruises.

The spleen is normal in size and in firmness, and lies quite behind the lower ribs. On its concave surface is a patch of pink discoloration, 3 inches by 2 inches, extending one-third of an inch deep into the substance of the spleen.

The stomach is still distended with a large meal of rice. At its cardiac end, where it lay in contact with the firm spleen, are two ruptures, close together, each sufficiently large to admit the tip of the forefinger; a few grains, only, of rice have escaped into the peritoneal cavity, together with a few drops of blood. The contents of the stomach, at cardiac end, are tinged with blood. There are no signs of disease or ulceration of the coats of the stomach, either at the region of the rupture, or elsewhere; they are normally thick at the edges of the ruptures. The mucous membrane is reddened for about two or three inches, and the external, serous, coat finely injected, for about one inch, round the region of the ruptures.

In this case, a normal, firm, spleen, and a healthy but distended stomach, were brought into violent collision; the result being that the spleen, on account of its firm, healthy, condition, was merely bruised, while the stomach suffered double rupture. Had the spleen impinged on an empty, elastic, stomach, it is probable that it would have suffered no injury; had the spleen been soft and enlarged, it would, probably, have been itself ruptured on the concave surface of collision, and the stomach would have escaped.

Healthy
spleen
bruised.

Stomach
distended.
Double
rupture of
the cardiac
end of
stomach.

Coats of
stomach
everywhere
healthy.

Death
mainly
from
shock.

Death seems to have occurred mainly from the shock, arising from rupture of the stomach and escape of some of its contents into the cavity of the peritoneum.

This recent
bruise
bright pink
in color.

It will further be remarked that, in this case, the bruise of the spleen was of a pink color, it being only seven hours' old at the time of dissection; whereas, in Case No. 33, when four days old, the bruise had a deep purple color; and, in Case No. 37, when three years old, it was quite decolorised.

General
remarks.

General remarks of the above four cases of Bruise of the spleen.

Causation.

Causation.—In three cases, the injury was the result of pounding the prostrate man with the feet, knees, and elbows, of assailants.

Notes on
assaults by
"pound-
ing."

This method of assault, while it is extremely likely to cause injuries to internal organs, yet, from the graduated nature of the violence, and the more or less soft, rounded, portions of the body used in inflicting it, is often unaccompanied by any sign of bruising on the surface of even a light colored skin; and, sometimes, there is an entire absence of bruising, or effusion, among the tegumentary and muscular tissues over the region of the viscera injured, as over the rest of the body.

Often
leaves no
mark on
skin.

And no
bruise in
skin or
muscles.

Case 33 il-
lustrates
this.

In Case No. 33, no signs of bruise or discoloration could be found on the skin of a fair-complexioned man, nor were any bruises or effusions found in the

tissues or muscles, on dissection, even over the region of the severely bruised spleen.

This method of assault is well understood, by the villagers, to be capable of causing pain and injury, without, in many cases, leaving any external signs of injury, especially on a dark skin. In cases which do not end fatally, it is not easy to give a decided opinion as to the nature of the injury—as it is not permissible to make exploratory incisions through the skin to ascertain the presence, or otherwise, of subcutaneous effusions.

This peculiarity understood by the people.
It renders diagnosis difficult.

In the one case caused by a fall, the nature of the injury seemed due to the accident of the spleen being healthy and firm, and the stomach being hard and distended with rice; in this condition, coming into violent collision, each viscus was injured at the surface of contact. It will be noted that the convex surface of the spleen escaped being injured by the direct shock. It will be seen, later on, in discussing the thirty-five cases of *rupture* of spleen, that, when the stomach is empty, the injury is commonly due to direct shock, and the convex surface suffers most frequently; but that, in cases in which the stomach is distended, it determines the injury to the concave (gastric) surface of the spleen. From this, we may conclude that as, in the above case, the spleen escaped injury to the convex surface from direct shock, it might also have escaped altogether had it been driven against an elastic, empty, stomach, instead of a hard, distended, one.

Factors of nature of injury.
Influence of the distention of the stomach in determining the injury and its seat.

Influence of the firmness of the spleen in causing it to escape rupture.

When the shock came, between the spleen on one side, and the mass of rice on the other, the coats of the stomach, intervening, were split in two places. This was due to the firmness of the spleen; for, in thirty-five cases of rupture of the spleen when that viscus was more or less large and soft, frequent cases occur of its being brought into collision with a distended stomach, and, in every case, the diseased spleen has been shattered (usually on concave surface), the stomach, in no instance, suffering.

Of 19 such cases, spleen ruptured in 18.

How rarely the spleen suffers merely the lesser injury of *bruise*, in cases caused by falls, is shown by the fact that, among nineteen cases caused in this manner, the present is the only instance in which the spleen suffered the minor injury of bruise,—in the eighteen other cases rupture invariably ensued.

In bruise of spleen, injury remained localised.

It is worthy of comment, also, that, in cases of bruise of the spleen, the injury seems to remain localised. In the two cases, Nos. 38 and 33, in which dissection showed the state of the spleen seven hours, and four days, respectively, after the viscus had suffered severe bruising, in neither case was there any general tumifaction or inflammation of the spleen tissue generally. The discolored patch of the bruise was strictly localised, and separated, by a sharply defined line of demarcation, from the rest of the spleen tissue, which showed no marked sympathetic irritation.

In bruise of lung

In marked contrast to this, was the behaviour of

the left lung in Case No. 33. This viscus, as well as the spleen, suffered bruising on its surface, and was found pink from ecchymosis; it, however, set up severe and increasing congestion of the neighbouring lung tissue, of which the man died in four days.

Survival and recovery in Bruises of spleen.

In the above quoted four cases of Bruise of the spleen, in two, recovery took place; in two, survival for periods of seven hours, and four days, respectively.

In the two fatal cases, it has been seen that the severity of the symptoms, and the fatal ending, were practically due to the severe complications of injuries to other viscera. Thus, in Case No. 33, the prominent symptoms were due to the bruising, and consequent congestion, of the left lung; as the congestion of the lung became more severe, the man's state became more critical, and death ensued when the lung mischief reached its climax.

In Case No. 38, too, death seems to have ensued from the shock of rupture of the stomach and escape of some of its contents into the peritoneal cavity.

In neither case, were there any signs of general inflammatory tumefaction or softening of the spleen found to have resulted from the injury it showed, and its injury seems to have gone for little in determining the fatal event, or its period.

In two cases, recovery took place.

In Case No. 34, the nature of the injury was inferred

diffuse
mischief
ensued.

Survival
and reco-
very.

In No. 33
fatal case,
death due
to injury of
lungs.

In case 38,
death due
to injury
to stomach.

In two
cases, reco-
very.

One case
not verified
by dissec-
tion, as pa-
tient still
lives.

from the nature of the violence, from the region of the external swelling, and from careful observation of the course of the symptoms during the eighteen days the patient survived under treatment. The symptoms and details of the case were carefully compared with those of other cases in which dissection had eventually proved bruising to have occurred in the spleen. The writer entertains no doubt as to the correctness of the diagnosis. But it will be seen that it was impossible to verify the diagnosis by actual inspection of the spleen, as the man recovered, and still lives.

Case 37, a
strong
case to
prove reco-
very possi-
ble.

Case No. 37 is, the writer thinks, a strong one to prove that injury of the spleen, of the nature of a bruise, may be recovered from.

In this case, there is a clear history of a severe assault by pounding with the feet, knees, &c., over the region of the spleen. One of the assailants, himself, gives the details of this, and of the illness which followed during the twenty succeeding days. On dissection, three years after, appearances were found on the spleen, in the region injured, exactly resembling what bruise-effusions would assume, after such a lapse of time, in such a viscus as the spleen.

Conclusion.

Simple
bruises of
spleen may
be recover-
ed from.

From consideration of the above cases, the writer thinks that the conclusion is warranted that injuries to the spleen, of the nature of Bruises, may be, and are, recovered from, when not complicated by injury to other viscera; and that, when complicated by injury to

ther viscera, the period and mode of the fatal ending
re, probably, more determined by such injury to
ther viscera than by the bruise proper of the spleen.

We shall see, later on, in discussing Ruptures of
the spleen, that the period of survival depends chiefly
on the rapidity and extent of the bleeding into the
abdominal cavity ; in one case (No. 35), though the
spleen substance was shattered in several places, yet,
as the leather-like capsule remained intact, and no
blood escaped outside it, the man survived for four
days ; while in another case (No. 14), though the
rupture was through the capsule, yet, as only a few
drops of blood escaped, the man survived for five
days, and died eventually of lung and heart injuries ;
while in the bulk of the thirty-five cases of Rupture
of the spleen, bleeding into the abdominal cavity was
copious and rapid, and the period of survival either
varied from a few minutes to a few hours, according
to the rapidity of the hæmorrhage, or, when this
latter was sudden and profuse, death was immediate.

When the injury is of the nature of a Bruise only,
no blood is effused into the abdominal cavity ; and, in
these cases, we have seen that, in two instances, re-
covery took place (in one, almost certainly—in the
other, presumably) ; while, in the two fatal cases, the
period and manner of death seemed entirely deter-
mined by the severity of the injury to the other
viscera—lungs and stomach—and not by the injury
to the spleen.

In ruptures
of spleen
bleeding
into abdo-
men large-
ly deter-
mines
period of
death.

In bruises
no bleed-
ing.

So more
chance of
recovery.

CHAPTER III.

Class II.—RUPTURES OF SPLEEN SUBSTANCE ; CAPSULE ENTIRE.

Class II. Definition:—Ruptures of the spleen substance inside capsule, which has remained intact.

Class II; its claims to be erected into a separate class. Among the thirty-nine cases of injury to the spleen on which these papers are founded, only a single case was of this nature ; but that one was, in its intrinsic characters and results, so distinct from ordinary ruptures, that it claims to be erected into the representative of a separate class.

Peculiar conditions of causation. An injury of this nature is only possible when the spleen is enlarged, and soft or friable, while, at the same time, the capsule is so exceptionally thickened and tough as to be able to escape, uninjured, the violence which has sufficed to rupture its soft contents.

Enormous thickening of capsule sometimes met with. In this typically malarious district, where malarial enlargements of the spleen are almost universal, one, not seldom, meets, during *post mortem* examinations, with cases in which the thickening, which the capsule of the spleen has undergone, is out of all proportion to the alterations in the viscus in other respects. Occasionally, the capsule is found dense, white, and as thick and tough as chamois leather.

This results, no doubt, from a chronic, low, form of inflammation causing hypertrophy of the fibrous tissue of the capsule by constant additions of organisable lymph, much as the fibrous tissue of the liver is hypertrophied in Cirrhosis.

Such a capsule may afford much protection to the enclosed spleen mass, and enable it to resist shocks of moderate nature; but this protection may be quite insufficient when the large, soft, spleen is violently crushed between the outside body inflicting the violence, the stomach, hard and distended on the inside, and the spine, and kidney, behind.

Such were the conditions in the present case.

Case No. 35. Chunkea Soobha—æt. 32—on 15th Case 35.
October, 1878, after taking a heavy meal of rice, went to the gymnasium; while exercising on the parallel bars, he slipped, and the region about the left lower ribs was brought into violent contact with the left bar. For some time previous, his spleen had been enlarged.

After the injury, he walked, with assistance, about 150 yards, to the hospital, where the writer saw him. There was no marked sign of collapse,—pulse was fairly strong,—no vomiting.

He complained of great pain over the region of the spleen, increased by motion. He was in hospital during the 15th, and his symptoms were carefully observed; on the 16th, his disease was entered as traumatic Inflammation of the spleen. During the 16th and 17th, no marked symptoms arose.

Tempera-
ture.
Pulse.

The temperature, however, remained at 100° ; the pulse was weak ; the pain about the spleen remained, and was much increased by the slightest movement, though he did not suffer to any extent while lying quiet ; the pain became acute on deep pressure being made over the region of the spleen, but that viscus could be detected, as a soft, ill-defined, mass, reaching as low as the umbilicus. There was no general distention or tenderness of other regions of the abdomen ; no signs of peritonitis. Soup and milk were taken, and retained.

Pain over
spleen.
Spleen can
be felt
as far as
umbilicus.

On the evening of the 18th, he died suddenly, while raising himself in bed.

Previous
absence of
severe
symptoms,

During the two days preceding death, the symptoms had been chiefly negative, beyond the severity of the pain, and the temperature remaining, permanently, nearly two degrees above the normal.

No signs
of bruising.

Post mortem examination, 15 hours after death:—
No signs of bruising, or of effusion, in the tissues or muscles of the regions struck.

Capsule of
spleen
like
leather.
Contained
a globular
mass of
firm clot
coagulated
in situ.

The capsule of the spleen enclosed an enormous, almost globular, mass. The capsule, itself, was dense, and as thick and tough as chamois leather. The greater portion of the mass, contained within the capsule, consisted of a large body of clotted, effused, blood, moulded to the cavity it occupied ; its dark color contrasting strongly with the lighter-colored, ex-sanguine, spleen substance proper ; this latter formed only about a fifth portion of the encapsuled

mass, and was very irregular in shape, projecting into the mass of the clot, and partially dividing it into several portions. The mass of clot, being moulded to the shape of the cavity it occupied, was welded in among these separated portions of the spleen tissue, and, between them, reached to the capsule, over certain portions of its internal surface.

The capsule, at the regions where spleen tissue was still in contact with it, was tough and white ; but, in the regions where the clot was in contact with it, was, in places, softened, and, in two regions, discolored.

Capsule soft and discolored where clot in contact with it.

There were seven large, and seven small, ruptures through the capsule, all being through the softened portions of it, and all leading direct to the clot mass.

One large starred fissure, $1\frac{1}{2}$ inch across, was at the region in contact with the stomach ; two fissures, on the outer side, were starred and irregular shaped, each from 1 inch to $1\frac{1}{2}$ inch across. At the lower posterior region, was a large gaping fissure, about 3 inches across, each way, where spleen was in contact with the hard spine ; the clot mass is, here, shattered as if a shell had burst in it ; the margins of the thick capsule are, here, softened and ragged ; this wound leads to a mass of clot almost detached from the main mass. The other three large fissures were of less extent.

Situation and relations of the large fissures through capsule.

The seven small ruptures were of the nature of shallow fissures, or scratches, through small softened

Several small shallow fissures or cracks.

patches of capsule, just touching the surface of the contained clot; they suggest the idea of cracks, from overdistention.

No rib was injured.

A broken fragment of clot found outside spleen capsule.

A broken fragment of clot was found among the intestines, near the spleen; this was of irregular shape, of rough surface, and, evidently, had not been effused in the liquid state among the intestines, or coagulated there; it seemed a piece of clot, from the main one inside the spleen capsule, broken off in the region where this mass was shattered by the posterior wound.

The other viscera were normal. The liver was not injured.

Stomach, condition of.

Stomach was empty at the time of *post mortem* examination, though it had been distended, at the time of injury, four days before.

Blood had clotted inside the capsule while this was still intact.

It will be observed that the clot-mass had, evidently, formed inside the spleen while the capsule was intact. It was accurately moulded to the irregular shape presented by the ragged, torn, portions of the spleen tissue proper; at the regions of the ruptures through the capsule, the solid clot-mass presented similar ruptures in its substance; and, at the region of the large posterior wound through the capsule, the solid clot-mass was shattered, one piece, having evidently been torn off, was found lying, free, among the intestines.

No fluid blood in abdominal cavity.

There was no fluid blood found in the abdominal cavity, nor any clot which had formed there.

It will be noted that the most extensive ruptures of the capsule and clot-mass were in those regions which lay in contact with, and were compressed against, the hard spine, and the stomach.

In the above case, at the time of injury, the enlarged spleen had, on its inner side, the stomach—Rationale of the injury. distended with a mass of rice—hard and resisting as a cannon-ball ; behind it, were the spine and kidney ; and it was enclosed by the ribs, on the outside.

In this condition, it was brought into violent collision with the parallel bar ; the result being, that Proof that capsule remained intact. the soft spleen tissue was shattered ; but it seems certain that the capsule, itself, remained intact, at the time of the injury.

Had the extensive ruptures through the capsule, found on dissection, occurred at the time of the injury, there must have been collapse, and, as the Bleeding into capsule too slow to cause collapse. man lived for four days, bleeding into the cavity of the abdomen must have occurred through the gaping wounds ; and the large clot-mass, fitting into, and distending the capsule, could not have formed. There was, however, no collapse, and no such bleeding.

After the rupture of the spleen tissue, then, bleeding must have gone on slowly into the capsule, but Capsule, distended, put a check to loss of blood. too gradually to cause symptoms of blood-loss. The capsule was gradually distended into the globular shape found on dissection.

During the four days of survival, the blood effused into the capsule seems to have become firmly coagu-

Capsule gradually softened where in contact with clot.

lated ; while the capsule became softened in portions where the clot lay against it, either from these regions having originally been bruised at the time of the collision (they were discolored, in two regions) ; or from maceration by the clot ; or from their being detached from the spleen tissue, and so having their normal nutrient blood-supply interfered with ; or from all these causes.

Patient raising himself in bed the spleen mass compressed suddenly against the hard spine.

When, on the fourth day, the patient raised himself in bed, the compression, exerted by the sudden contraction of the abdominal muscles, was, apparently, sufficient to cause the greatly distended capsule to burst, in these several softened patches ; and, from the posterior rent, a piece of clot became detached. The sudden rupture of this blood-distended spleen was followed by the immediate death of the patient.

The large posterior rent was just where the globular spleen mass was compressed against the hard spine.

Loss of blood limited by the capacity of distended capsule.

The absence of symptoms of blood-loss was doubtless due to the fact that the dense capsule of the spleen resisted distention, and, that, when the limit of distention had once been reached, no further hæmorrhage was possible.

In its final ending, this case was, practically, one of rupture of capsule, and of clot-mass, by muscular action.

Medico-legal deductions.

Some interesting medico-legal deductions may be drawn from the facts of this case.

It shows that, though extensive injury to the spleen tissue may have taken place, yet, if there be no effusion of blood into the cavity of the abdomen, no marked symptoms of collapse may occur, and the injured person may be capable of considerable exertion after having received the injury.

In rupture, if no bleeding, symptoms slight.

It shows, too, that survival may be long, and that marked symptoms, due to the severe injury of the spleen, may be so absent as to disguise the true gravity of the case. In the present instance, the real gravity of the injury was not suspected.

The absence of collapse at the time of the injury, the survival of the patient, the continued absence of prostration and of peritonitis, all tend to lead to the opinion that, at most, a bruising, only, of the spleen has occurred.

In spite of the absence of prominent or grave symptoms, the prognosis, in cases of violence over the region of the spleen, should be most guarded. For, as in this case, secondary changes in a primarily intact capsule may cause eventual rupture, and death may ensue, after the symptoms, for some days, have been scarcely more severe than may result from merely bruises of the external tissues, though such death is essentially and wholly due to the primary injury.

Great caution necessary in prognosis, in cases of violence over region of spleen.

After the injury, and during the period of survival, the injured man may walk considerable distances, or even carry loads; and, when death eventually occurs,

Such cases may suggest that some further, or secondary,

injury
must have
been the
immediate
cause of
death.

it may be (and has been, in the writer's experience) urged that death must have been due to some further injury, or accident; and this view of the case has, on the face of it, an air of probability which commends it, as a form of defence, to the friends, or counsel, of the accused, in case the injury has been received in a quarrel.

Symptoms,
all depend
greatly on
the pre-
sence or
absence of
hæmorrhage
into
cavity of
abdomen.

It will be noted, later on, that, throughout the thirty-nine cases of injury to the spleen, considered in these papers, the facts warrant the conclusion that the presence or absence of immediate symptoms of collapse, the power of exertion, the period of survival and the symptoms during that period, depend, not so much on the extent of the real injury the spleen has suffered, as on whether, from the nature and position of the injury, and the state of the spleen, copious and sudden effusion of blood into the cavity of the abdomen, does, or does not, take place.

When the injury (as in the case of a Bruise, or as in the present instance) causes no such hæmorrhage, the symptoms may be so slight as to entirely mask the real nature and gravity of the case.

Medico-legal
note.

In the above-detailed case, had the primary violence been inflicted by a blow, in a quarrel, instead of by an accidental fall against a bar, it might, with some ostensible plausibility, have been contended that, as the patient survived the primary injury for four days, the eventual fatal ending must have been, in some way, contributed to, by some new injury or misadventure.

Practically, we see that the inevitable, though deferred, death was entirely, and distinctly, due to the primary injury and the changes resulting from it.

It is worthy of note, in the present case, that when the hard, distended, stomach was brought into violent collision with an enlarged, soft, spleen, the stomach itself escaped uninjured, while the spleen suffered the severe and extensive ruptures of substance, above detailed.

Hard
distended
stomach in
collision
with en-
larged soft
spleen.

Stomach
escaped

In connection with this case, it is interesting to recall the details of Case No. 38, for comparison.

In this latter case, the firm, healthy, spleen was driven against a distended, hard, stomach, by violence similar to that producing the injury in the former instance.

Spleen
shattered.

In Case 38, however, the firm spleen merely suffered a bruise on the surface of contact with the stomach, while the stomach itself, though healthy as to its coats, was ruptured, in two places, at its cardiac end, where it came into collision with the firm spleen.

Compare
case 38,
spleen
bruised.
stomach
ruptured.

These two cases were, in the mode of causation of injury, similar in every respect save one, *viz.*, the condition of the spleen as regards firmness, &c. This condition, then, was the one, which determined the different nature of the injuries, in the two cases.

Only one
point of
difference,
viz., the
condition
of spleen.

Therefore, so far as we have as yet gone, we may conclude that the condition of the spleen, as regards firmness, &c., not only determines whether it shall suffer injury or no, and of what nature this injury

This then
was cause
of differ-
ence in
result.

will be, but also, what injury the spleen may inflict on contiguous viscera.

In Case
No 1, firm
spleen
caused rup-
ture of
colon.

We shall see, later on, in Case No. 1, that a spleen, firm in consistency, when driven forcibly inwards by external violence, inflicted a rupture on the colon at the angle of the junction of the descending and transverse portion,—*i. e.*, just at the region on which rests the lower, pointed, end of the spleen.

In this case, too, there was no rib broken, so that the injury could not have resulted from piercing by the end of a fractured rib.

CHAPTER IV.

Class III.—RUPTURES OF SPLEEN TISSUE AND CAPSULE.

Head I.—*Nature of the violence causing the injury.*

Head II.—*Extent—Site—Direction—of injury, with regard to nature of the violence.*

Class III.—*Definition* :—In this class, are grouped Definition.
those cases in which the spleen tissue, and capsule, are, both, ruptured at the time of the injury. By far the greater number of cases of injury to the spleen are of this nature. Of the thirty-nine cases of injury to the spleen on which these papers are founded, thirty-four were of this class. For the sake of clearness, we may, here, recapitulate briefly, much of what has already been noted under the head of Causation of injuries of the spleen generally, *viz.* :—

That malarial enlargements of the spleen are almost universal in Lower Assam ; that, in enlarging, the spleen usually becomes friable, or soft, often to such an extent as to be aptly described as a “ bag of blood.” In enlarging, it extends below the ribs, and has, then, only the thin plane of abdominal mus-
Conditions of causation
Spleen enlarged, and soft or friable.
Extends below ribs.

cles in front of it, these muscles being, often, abnormally thinned by the cachectic state of the individual.

The spleen, in this condition, is in close contact with hard bodies, on certain sides : the spine, and left kidney, behind ; the stomach (distended, at regular intervals, by prodigious meals of rice), on the inner side ; it is enclosed by the ribs, on the outer side ; and has, above it, the diaphragm, intermittingly tense in respiration.

In contact
with hard
bodies :
Spine,
Kidney,
Ribs,
Diaphragm,
Stomach.

The soft spleen, extending, perhaps, to the pubes, is very liable to rupture, from direct blows over it ; and such rupture may be either on the surface immediately receiving the shock, *viz.*—convex—or, by contre-coup, on the opposite, or concave, surface ; or the large, soft, spleen may be driven against the distended, hard, stomach, the spine, or the left kidney, and shattered, on one or both surfaces, from the crush it receives between the external violence and the internal hard body.

In case of
extreme
violence
healthy
spleen
may be
ruptured.

Even when the spleen is fairly healthy and firm, it may be ruptured, when the violence is excessive, as in heavy falls (Cases Nos. 13 and 14), or by blows of great severity (as in Case No. 6) ; in which case, other viscera, also, are usually injured by the extreme nature of the violence. In two of the above-mentioned three cases, there were injuries to other viscera. The healthy spleen, too, is especially likely to sustain injury, if it be taken, between this violence, on the outside, and any hard body, such as a distended,

ward, stomach, on the inside ; in which case, the stomach, also, may suffer rupture, on the firm spleen (as in Case 38).

Cases of rupture of the spleen, under Class III, are so numerous, and their points of interest so many and important, that further consideration of these injuries will be facilitated by discussing them under the following heads :—

I. The nature of the rupturing violence. With Table I.

II. The extent, site, and direction, of the injury, with regard to the mode of violence. With Tables II and III.

III. *The condition of the stomach*, as influencing the nature of the injury. With Table IV.

IV. *The condition of the spleen*, as regards health, or disease, as influencing injury. With Table V.

V. *Period of survival—Possibility of recovery—degree of repair of spleen-wound—and conditions influencing survival.* With Table VI.

VI. *Injuries of other viscera*, complicating injuries of the spleen. With Table VII.

a. Lungs. With Table VIII.

b. Stomach.

c. Intestines.

d. Heart.

e. Liver.

f. Kidneys.

g. Bones, and external tissues.

Discuss
these in-
juries
under
six heads.

Heads
under
which
discussed.

Head I.—The nature of the violence causing the injury:—

TABLE I.

Analysis of nature of the violence causing injury to Spleen, in Thirty-nine Cases (of all classes).

39 Cases ... { 35 Ruptures.
4 Bruises.

A.—FALL (19).

Falls from heights ... { Ruptures ... 18
Bruise ... 1

B.—BLOWS (16).

a.—With hand ... 2—both Ruptures.
b.—With bamboo, stick, &c. ... 6—all Ruptures.
c.—Pounding with knees, elbows, &c. 5 { 2 Ruptures.
3 Bruises.
d.—With yoke of plough ... 1—Rupture.
e.—With heavy wooden mallet ... 1—Rupture.
f.—Man's body, bar of wood ... 1—Rupture (Class II).

C.—OTHER KNOWN CAUSES (3).

a.—Gunshot ... 2—Wounds.
b.—By tiger ... 1—Rupture & wound.

D.—CAUSE NOT KNOWN.

1—Rupture.

Nature of
violence.

It will be seen that, in thirty-nine cases, nineteen were caused by *falls*, sixteen by *blows*, two by *gunshot*, one by *tiger*; while, in one case, the nature of the violence was not certainly known.

Blows, 16:
nature of
weapon.

Of the sixteen injuries caused by *blows*, two were caused by blows with the hand; six, by blows with bamboos, latties, or similar weapons; five, by pounding with feet, knees, &c., of assailants; one was caused by the yoke of a native plough being dashed, violently,

against the prostrate ploughman, the oxen having *tamped*; one was caused by a blow, over spleen, with a very heavy wooden mallet; one was caused by a slip on the parallel bars, at the gymnasium—the man was exercising after a heavy meal, the left side was struck against the left bar, and the spleen crushed between the distended stomach and the bar.

In the last three cases, there is distinct and direct evidence of the extreme severity of the violence causing the injury; and, in each case, the violence impinged immediately over the region of the spleen. It will be seen, later on, that, in each of these cases, the injury resulting was, as might be expected, very severe and extensive.

In the five cases caused by pounding, it is more difficult to exactly gauge the degree of severity of the violence causing the injury. In this form of violence—pounding with the knees, feet, elbows, &c., of assailants—the amount of violence actually exerted may be of very varying degree of severity, and admits of being graduated according to the wishes, or energy, or persistency, of the assailants. Moreover, as a result of the more or less rounded and elastic nature of the parts—elbows, feet, knees, &c.—which are the media of application of the violence, the nature of the resulting injury often differs in a marked manner from that which, as we shall see presently, almost uniformly and invariably ensues from falls or from blows of an ordinary nature. Consequently,

we find, that, in the five cases caused by violence of this kind, the resulting injury to the spleen took the form of bruise in three cases—of rupture, in two only.

Head II.—The extent, site, and direction, of the injury, as influenced by the nature of the violence:—

TABLE II.

Analysis of Thirty-nine Cases of injury of Spleen.

Extent—Site—Direction—of injury, and nature of violence.

A.—FALLS (19).

Ruptures (18).

| | | | | |
|--------------------------------------|---|---|---|---|
| 3 | { | Spleen split in two, transversely ... 2 | { | 1—Stomach full; rupture on concave. |
| | | Spleen split in two, longitudinally ... 1 | | 1—From both surfaces. |
| 9 Extensive or Multiple Ruptures ... | { | On convex only ... 2 | { | 1—Torn by broken ribs. |
| | | On convex and concave ... 3 | | 1—Four ruptures, transverse. |
| | | On convex and concave ... 3 | | 1—Three on convex, one on concave. |
| | | On convex and concave ... 3 | | 1—One on convex, starred one on concave. |
| | | On convex and concave ... 3 | | 1—Three on convex, two on concave (stomach full). |
| 6 Single Ruptures ... | { | On concave only ... 2 | { | 1—Many ruptures, longitudinal. |
| | | On concave only ... 2 | | 1—Two ruptures, one starred (stomach full). |
| | | Posterior edge ... 2 | | 1—Posterior edge shattered, and on convex. |
| | | Posterior edge ... 2 | | 1—Posterior edge, and concave, transverse. |
| 6 Single Ruptures ... | { | On lower margin ... | { | 1 |
| | | On concave ... | | 1—Transverse. |
| | | On convex ... | | 3—Transverse. |
| | | On unknown region ... | | 1 |

Bruise (1).

On concave; stomach full, and was itself ruptured.

B.—BLOWS (16).

- a.*—With hand (2) { 1—Single rupture on concave (stomach full).
1—Single rupture on front edge.
- b.*—With bamboo, stick, &c., (6) { 1—Single on concave.
1—Ditto on anterior margin (stomach full).
Ruptures. { 2—Single on convex.
2—Not certainly known.
- c.*—Pounding (5) { 1—Starred rupture on concave (stomach empty).
Ruptures ... 2 { 1—Rupture, nature not recorded.
Bruises ... 3 { 2—On convex, (stomach empty).
3 Bruises { 1—Probably convex, man lived.
- d.*—By yoke of plough. { 1—Split in two, transversely, from both surfaces.
- e.*—With heavy wooden-mallet. { 1—Two on concave, one on convex, transversely (stomach full).
- f.*—Man's body against a fixed bar. { 1—Spleen tissue shattered, capsule intact (Class II) (stomach full).

C.—OTHER VIOLENCE (4).

1—Unknown. 2—Gunshot. 1—Tiger.

Table II contains analysis of thirty-nine cases.

A.—Of the nineteen injuries from *falls*, eighteen were *ruptures*; only one, a *bruise*. Of the eighteen *ruptures*, in twelve the injury was multiple, or extensive.

Falls.
Ruptures, 18.
Bruise, 1.

Spleen
split in
two.

(a.) *Extent of Injury by falls.*—The spleen was

Extent of
rupture.

more or less completely divided into two parts, in three cases; transversely, in two cases (in one of which the stomach was full, and the rupture was from concave surface); longitudinally, from convex surface, in one.

Rupture
single in 6.

The *ruptures* were multiple, or very extensive, in nine other cases; single, in six others.

Only one
bruise by
fall.

In the unique case of *bruise* of spleen from a *fall*, the spleen was firm and healthy, and was

Details of.

bruised, on the concave surface, against a distended stomach, which latter was, itself, ruptured, in two places, on the surface of contact.

The cases
of multiple
or severe
injury.

In the nine other cases of multiple, or extensive, *rupture*, the injury was, usually, very severe; the convex surface suffered in six instances: alone, in two; with the concave surface, in three; with the posterior edge, in one. In one instance, the convex

Which
surface
suffered?

surface was shattered by the broken ends of several ribs; in another, it had four transverse ruptures; in another, there was a transverse rupture, on the convex surface, besides a cross-shaped one from end to end of the concave surface. In a fourth case,

Extent
and num-
ber of the
injuries.

where the spleen had been shattered against a distended stomach, there were five ruptures—three, on convex, and two, extensive ones, on concave surface. In a fifth case, the spleen was crushed against the spinal column; the posterior edge, and contiguous portion

Cases illus-
trating

of convex surface, were shattered. In a sixth case,

the posterior edge, and concave surface, were both extent of rupture. ruptured transversely. In a seventh case, the concave surface had several longitudinal ruptures. In the eighth case, there were four transverse ruptures—one on concave, three on convex.

In the ninth case, there were two transverse ruptures across concave surface, the lower one passing through, and being starred behind, the hilus.

In the six cases of single and non-extensive *rupture*, from *fall*, the lower end of the spleen suffered in one instance; the concave, in one; the convex, in three; the rent being transverse in the latter four cases. Single ruptures. Site. Extent. Direction.

(b.) *Position of the injury, in fall cases.*—Of nineteen cases of injury by *falls*, the situation of the injury was known in eighteen. Tabular statement of position of rupture in 18 cases by fall.

The regions of the spleen suffered, as follows :—

| | | |
|--|-----|---|
| The <i>convex</i> only, suffered in | ... | 6 |
| The <i>convex</i> , with <i>concave</i> , in | ... | 4 |
| The <i>convex</i> , with posterior edge, in | ... | 1 |
| The <i>concave</i> only, in | ... | 5 |
| The <i>concave</i> , with convex (as noted above), in | ... | 4 |
| The <i>concave</i> , with posterior edge, in | ... | 1 |
| The posterior edge { with concave, 1 with convex, 1 (as noted above) } | ... | 2 |
| The lower end only, in | ... | 1 |

Of the three cases in which the spleen was split in two, or nearly so, in one instance the concave was the surface from which the rent started,—in this In cases of spleen split in two. Site, &c., of injury.

case, the fissure was transverse, and the stomach was distended ; in another, the rent was longitudinal, on the convex—condition of stomach not recorded ; in the third case, the ruptures were from both surfaces.

Thus, in these eighteen cases, in which the site of the injury was known, in injuries by *falls* from a height :—

| | | | | |
|---|--|-------|-------|-------------|
| Rupture by falls, frequency of injury of each region of spleen. | <i>Convex</i> surface suffered, alone, or with others, in 11 | | | |
| | <i>Concave</i> | ditto | ditto | ditto in 10 |
| | <i>Posterior edge</i> | ditto | ditto | ditto in 2 |
| | <i>Lower end</i> | ditto | ditto | ditto in 1 |
| | <i>Anterior margin</i> } | ditto | ditto | ditto in 0 |
| | <i>Upper end</i> | | | |

In 3 cases by fall, stomach distended ; *falls*, in which stomach was known to be distended, the concave invariably suffered, and the injury was most severe ; viz., in one case, the spleen was split in two, from the concave surface ; in another, there were five ruptures, two extensive ones being on concave ; in the third case, there were two ruptures, both on concave—one, extensive and starred.

Summary in ruptures by falls. Thus, in cases (in which the site of the injury was known) caused by *falls* (in which the amount of violence is extreme and overpowering, and the shock to the spleen sudden and crushing, causing direct rupture or shattering it against the spine or full stomach), the injury is, usually, extensive, and severe (in 12 out of 18 cases) ; the convex surface most commonly suffers (often in common with the concave)

Injury usually extensive. Convex usually suffers.

From the direct concussion of the blow (or its contre-coup) ; the concave surface is often injured (in 10 out of 18 cases); it, alone, suffered, in only five out of eighteen cases, and, in three, of these five cases, the distended stomach seems to have determined the injury on this surface ; in none of the eighteen cases did the concave, alone, suffer, when the stomach was recorded as certainly empty. It will be shown, later on, that though, in all ruptures of the spleen, whether from *blows* or *falls*, the convex surface suffers (alone, or with other regions) more frequently than any other portion of the spleen, yet this preponderance of injury to the convex alone, is much less marked in the case of injuries by *falls*, than in those by *blows*.

Concave
in 10 out of
18 cases.

In all
ruptures,
convex
surface
most
frequently
suffers.

In the two cases in which the posterior margin suffered, the spleen had been burst against the spine, or the left kidney, though this latter viscus was not injured in either case.

Posterior
edge burst
in two
cases.

In one case, the lower end of spleen suffered.

Lower end.

In no case, did the anterior margin, or the upper end, suffer from *falls*.

Anterior
edge.

(c.) *Direction of the rupture in injuries by falls*.—In seventeen cases of *rupture*, in which direction of the injury was known, this was—

Tabular
statement
of direction
of injury
in cases by
falls.

| | | | | | |
|--|-----|-----|-----|-----|----|
| <i>Transverse</i> , in | ... | ... | ... | ... | 12 |
| <i>Longitudinal</i> , on a surface, in | ... | ... | ... | ... | 2 |
| <i>Along lower margin</i> , in | ... | ... | ... | ... | 1 |
| <i>Surface shattered</i> , in | ... | ... | ... | ... | 2 |

B—Injuries by blows.

Injuries by blows. (a.) *Extent*.—Sixteen injuries were so caused. Of these sixteen cases, thirteen were *ruptures*, three *bruises*.

Ruptures, 13.
Bruises, 3. Of the thirteen *ruptures*,—one was of Class II, —twelve, of Class III (Ruptures of spleen tissue, and capsule, at the time of injury) ; of the latter twelve *ruptures* from *blows*, the exact nature is only recorded in nine.

Of these nine known cases, the *rupture* was single and not severe, in six ; severe, or multiple, in three.

Single ruptures from blows. Two, of these six single-ruptures, were caused by blows with the hand ; the other four were caused by blows with bamboo, stick, or such-like weapon.

In no case, did blows with the hand, bamboo, or stick, cause other than a single, non-extensive, rupture.

Multiple injury by blows. In the three cases of multiple, or extensive, injury, caused by *blows*, the violence was of great and crushing severity.

Thus, in respect of causation, and of extent of injury, these three cases resemble those produced by *falls*, noted above.

Case by very severe pounding. In a case in which a man was pounded, severely, by the knees, feet, and elbows, of several assailants, there was a large, star-shaped, rupture on the concave surface ; the pounding and crushing violence, in this case, is reported as very severe.

One by severe In a case in which a man was struck, with

extreme violence, by the yoke of a plough, as the blows with oxen bolted, the spleen was split, transversely, from yoke of plough. both surfaces, almost in two.

In the case in which a blow with a heavy wooden-mallet produced the injury, the violence was excessive, the spleen was crushed against the distended stomach, and split, transversely, in three places : two, on concave,—one, on convex. One by blow with a massive mallet.

Three cases of *bruise* of spleen were caused by Bruises, three cases. pounding with knees, &c., of assailants.

(b.) *Site of injury* (in cases from blows). By blows. Site of injury.
Of the three cases of *bruise*, two were on convex surface ; the third was, probably, so, but this was not certainly ascertained, as the man is still living.

Of the six cases of single *rupture*, in which the site of injury was recorded— Of six cases of single rupture by blows, Statement of site.

| | | | |
|--|-----|-----|---|
| The anterior edge suffered, in | ... | ... | 2 |
| The convex surface, in | ... | ... | 2 |
| The concave surface (stomach full, in one), in | | | 2 |

Taking *bruises* and single *ruptures* (caused by *blows*) together, we see that the convex surface, and anterior edge, especially suffered.

One injury to the concave surface seemed determined, to that surface, by the spleen impinging against a hard, distended, stomach, internally.

In three cases of multiple, or extensive, *rupture*, by *blows*, we find that the injury was on— In three cases of multiple rupture from blows. Site.

| | |
|---|---|
| Convex, and concave (stomach full, in one)... | 2 |
| Concave alone | 1 |

Concave in all.

The concave, therefore, suffered, in all three cases in which the violence had been extreme.

In these three cases of multiple, or extensive, *rupture*,—in all, the violence was inflicted by a heavy mass, and was of a severe, overpowering, nature. They may, therefore, practically be considered as having been caused by a mode of violence similar to a *fall* from a height.

Cases from crushing blows resemble cases from falls.

When a man is pounded by heavy men jumping on him ; when a massive plough-yoke is dashed, by galloping oxen, against a prostrate man ; or when a person is struck over the spleen with a heavy mass of wood, such as a mallet ; the mode of injury is, practically, much the same as when a man *falls* from a height ; and it is seen that, in all these cases, the injuries resulting are very similar, in extent, and in situation.

We may, therefore, state the above cases thus :—

By falls, or blows of massive bodies.

| | | | |
|--|-----|-----|----|
| <i>Injuries</i> caused by <i>falls</i> | ... | ... | 19 |
| <i>Injuries</i> caused by <i>crushing blows</i> of massive bodies... | ... | ... | 3 |

Injuries by *falls*, or *blows* of massive bodies... 22

By blows of non-massive bodies.

| | | | | |
|--|-----|-----|-----|---|
| <i>Injuries</i> by <i>blows</i> of non-massive bodies— | | | | |
| Ruptures | ... | ... | ... | 6 |
| Bruises | ... | ... | ... | 3 |

} 9;

and thus analyse them :

TABLE III.

Degree of injury, and site, with regard to degree of violence.

| | Cases. | RUPTURE. | | On regions deepest from skin surface. | On regions nearest to skin surface. |
|--|---------------|------------------------|---------|---|---|
| | | Multiple or extensive. | Single. | | |
| 22 { <i>Falls</i> or <i>Crushing Blows</i> of massive bodies ... | { 21 Ruptures | 15 | 6 | *15 viz :— | 13* |
| | { 1 Bruise. | | | † <i>Concave</i> (<i>Stomach full in 5.</i>) <i>Posterior edge</i> ... 2 <i>Lower end</i> ... 1 1 Bruise <i>concave</i> . | †Convex ... 13 |
| | { 6 Ruptures | None. | 6 | 2 viz :— | 4 viz :— |
| 9 <i>Blows</i> of non-massive bodies | { 3 Bruises. | None. | None. | Concave ... 2 (<i>Stomach full in 1.</i>) | Convex ... 2 Anterior edge ... 2 2 Convex ... 2 |
| | 31 | 15 | 12 | 18 | 19 |

* The same case may appear under more than one head, if the injury was on more than one region.

† Often on other regions also.

General resumé of extent and site of injury.

By falls :
multiple,
single.

(a.) Of twenty-one cases of *rupture* (under Class III) by *falls*, or by *crushing blows* of massive bodies, the injury was multiple, or very extensive, in fifteen ; single and non-extensive, in six.

By blows,
non-mul-
tiple.

(b.) Of six cases of *rupture* from *blows* with non-massive bodies, in no case was the injury multiple, or extensive.

Deduction.

Thus, in *ruptures*, caused by *falls*, or by *blows* of massive bodies, the injury was, most frequently, (15 cases out of 21) multiple, or extensive ; in *ruptures* caused by *blows* of non-massive bodies, the injury was always single, and not extensive.

Pounding, 5
Ruptures, 2
Bruises, 3

(c.) *Pounding with* knees, elbows, feet, &c., of assailants. Of five cases of injury by this form of violence,—in one, the violence was very severe, and there was a large, starred, *rupture* on the concave surface ; in one other case, there was a *rupture*, surface unknown ; in three other cases, such poundings only produced *bruises* : in two of them, on convex ; in the third, probably, on convex, but not certainly known, as the man is still living.

Cases of
pounding.
Deduction.

Thus, in cases of injury by *pounding*, the spleen often escapes *rupture*, and only suffers the lesser injury of *bruise*, especially if spleen be more or less healthy, and the stomach empty.

By falls,
injury
deep or
near sur-
face of
body ;

(d.) Of twenty-one cases of *rupture*, and one of *bruise*, by *falls*, or by *crushing blows* of massive bodies, those regions of the spleen furthest from the skin

surface suffered, in sixteen ; those regions nearest the ^{frequency} of. skin surface, in thirteen. In several, both regions suffered.

(e.) Of six cases of *rupture*, and three of *bruise*, ^{By blows, injury deep or near surface of body ; frequency of.} caused by *blows* of non-massive bodies, six were on those regions of the spleen nearest to the skin surface of body ; two, on the regions most remote from it ; and, in one of these last two, the stomach was known to have been distended, and it, probably, therefore, determined the injury to the deep regions of spleen, in that case.

Thus, violence from *falls*, or from *blows of massive* ^{Deductions by falls or blows.} bodies, most frequently causes injury of those portions of the spleen deepest in the body ; often, of the less deep regions, as well.

Violence from *blows of non-massive* bodies, most ^{Frequency of injury, deep or near body surface.} frequently causes injury of the portions of the spleen less deep in the body, but may cause injury to the deeper portions, if these have, in contact with them, internally, a hard body, such as a distended stomach.

(f.) Of eighteen *cases*, in which, from both classes ^{Total injuries on deep portions.} of violence; *those surfaces, or edges, of the spleen, most distant from the surface of the body* suffered (either *rupture*, or *bruise*), these regions were :—

| | | | | | |
|----------------|-----|-----|-----|----|-------------------|
| *Concave, in | ... | .. | ... | 16 | On which region ? |
| Posterior edge | ... | ... | ... | 2 | |
| Lower end | ... | ... | ... | 1 | |

* One case shown under concave, and under posterior, as both of these regions were injured.

Deep in-
juries by
falls:

Of sixteen cases in which these deep injuries were from *falls*, or from *blows with massive* bodies, these injuries were on :—

| | | | | | |
|----------------------|----------------|-----|-----|-----|----|
| Which sur- face ? | Concave, in | ... | ... | ... | 14 |
| | Posterior edge | ... | ... | ... | 2 |
| | Lower end | ... | ... | ... | 1 |

Deep in-
juries by
blows :
Which sur-
face ?

In two cases, in which these deep injuries were from *blows with non-massive* bodies, the injuries were on the concave, in both.

Deduction
from
above.

Thus, when a *region of the spleen most deep from skin surface of the body* suffered injury, from any kind of violence, the concave surface was the region, by far most frequently, injured.

When the deep injury resulted from a *fall*, or *blow with a massive* body, it was, occasionally, on posterior edge, and, in rare instances, on lower end.

Frequency
of each
region
suffering.

When this deep injury was inflicted (it rarely was) by *blows of non-massive* bodies, the concave invariably suffered—the posterior edge, and lower end, escaping.

Upper end. The upper end enjoyed complete immunity, in all cases.

Injuries to
portions of
spleen
near skin
surface.
Region in-
jured.

(g.) *Of nineteen cases of injury to regions of spleen nearest to skin surface of body*, the injury was on :—

| | | | | |
|-------------------|-----|-----|-----|----|
| Convex, in | ... | ... | ... | 17 |
| Anterior edge, in | ... | ... | ... | 2 |

When by
falls.

Of thirteen cases in which this injury was caused by *falls*, or by *blows of massive* bodies, it was on :—

Convex in all

Of six cases in which this injury was caused by When by blows.
blows of non-massive bodies, it was on :—

| | | | | |
|---------------|-----|-----|-----|---|
| Convex | ... | ... | ... | 4 |
| Anterior edge | ... | ... | ... | 2 |

Thus, when a *region of the spleen nearest the skin* Frequency of injury on each region.
surface of the body suffered, from any kind of violence,
the injury was, almost invariably, on the convex.

When the violence causing this injury was a *fall*, or When by falls.
blow with a massive body, the injury was, invariably,
on the convex.

When the injury was caused by *blows with non-* When by blows.
massive bodies, the convex surface, and anterior edge,
suffered in the proportion of 2 to 1.

In all cases of injury to the spleen, from what
cause soever, the upper end invariably escaped.

Conditions determining the site of injury.—From Conditions determining site of injury to spleen.
the great extent of its two surfaces ; from the spleen
being most thin and weak in a direction from sur-
face to surface ; and from most of the concussions
necessarily impinging on the external surface (so
extensively in contact with the parietes of the body) ;
it follows that the greater number of injuries will,
naturally, occur on the two surfaces of spleen.

When a blow impinges on the external surface of Convex may rupture from direct shock : concave, from contrecoup ; or crushed against distended stomach.
the spleen, it may directly rupture the portion of the
spleen primarily receiving the concussion,—*i. e.*, con-
vex surface, or be transmitted to the large internal sur-
face in contact with the cardiac end of the stomach : if
the stomach be empty, it is elastic, and yielding ; but

the spleen, though it meet with no resistance on its internal surface, may still be ruptured, on that surface, by *contre-coup* ; if, however, the stomach be distended, hard, and resisting, the spleen, taken between the external force and the unyielding stomach, may be shattered, on one, or both, of its surfaces.

Light,
sharp
blow
tends to
injure the
convex.

A sharp blow with some light body, such as the hand, or a stick, will tend to injure the convex (external) surface, which primarily receives the concussion ; a crushing blow with a massive body, or a fall, will tend to be transmitted, and to crush the spleen against some internal, resisting, body—either the full stomach, or spine, or kidney.

Fall or
crushing
blow,
concave.

Hence the preponderance of injuries on the two surfaces of the spleen : on convex, from light blows ; on concave (or both), from crushing violence by massive bodies.

Anterior
margin
rarely
struck.

The anterior margin of the spleen, presenting a very small mark, probably does not frequently receive a direct blow ; it may be directly ruptured, at the part struck, by even a light blow, if the spleen be very large and soft (as, in Case 4, by the hand).

Posterior
edge.

By a heavy blow, the spleen may be driven against the spine or the left kidney, and, so, the posterior margin be ruptured.

Extremi-
ties.

The upper and lower ends are, more or less, out of reach of direct accidents, and rarely suffer.

Rationale
of escape
of upper
and lower

It is notorious how inevitably a heavy blow over the abdomen, or chest, tends to cause sudden emptying

of the chest (vulgé "breath knocked out of the body") and, even if the blow be expected, it is difficult to control this, by voluntary effort. Hence, in the case of shock to the spleen, transmitted in every direction through that viscus, probably the diaphragm, by the primary effect of the blow on the body, is, immediately, forced upwards into the chest, and tension in this direction relieved, before the spleen, itself, impinges, with dangerous violence, on the diaphragm; while the elastic coils of the mobile intestine, in contact with the lower end of the spleen, would soften the shock in that direction; and, so, both upper and lower ends of the spleen tend to escape injury. The above Tables, II and III, show that these two ends of the spleen practically enjoy immunity from injury.

ends of spleen from injury.

Both ends enjoy practical immunity.

In Chapter V, and in Chapter VIII (Head *b.*), is fully discussed the influence exerted by the distended and hard, or the empty and elastic, condition of the stomach, both in determining the site of the injury to the spleen—whether to concave, or convex, surface—and in deciding whether, or no, any injury whatsoever shall occur, from the incidence of certain violence.

Site of injury influenced by condition of stomach.

From statistics, noted in those chapters, it has been deduced that, in cases of injury to the spleen,

Proportion concave to convex

when stomach was *full*,

when stomach full.

frequency of injury to concave } was to { frequency of injury to convex } as 3 to 1.

when stomach was *empty*,

When stomach empty.

frequency of injury to concave } was to { frequency of injury to convex } as 1 to 4.

Ratio of
concave
when
stomach
full to
when it is
empty.

moreover,

frequency of injury }
to concave, } was to { frequency of injury to } as 4 to 1
when stomach full } { same surface, when } nearly.
stomach empty }

From the above statements, we deduce the fact that injury to the concave surface was nearly four times as frequent when the stomach was full, as it was when that viscus was empty.

Deduction.

The conclusion seems evident that the hard, distended, condition (from food) of the stomach was, frequently, the cause which determined the injury to the concave surface of the spleen.

Full
stomach
injury to
concave.

In Chapter V, too, it is shown that this distended condition of the stomach was, in all probability, the main cause why, in certain cases (such as Nos. 1, 14, 35, 38), injury of any nature was suffered by the spleen.

Direction
of rup-
tures
by light
blows.

(c.) *Direction of injury*, in cases of *rupture by blows*.

In five cases of *rupture* of spleen by *blows with light* bodies, such as the hand, a stick, &c., the direction was—

| | | | | |
|----------------------------------|-----|-----|-----|---|
| <i>Transverse</i> , in | ... | ... | ... | 2 |
| <i>Longitudinal</i> , in | ... | ... | ... | 1 |
| <i>Down anterior margin</i> , in | ... | ... | ... | 2 |

Direction
of rup-
tures by
crushing
blows.

In three cases, caused by *crushing blows* with heavy masses, the direction was—

| | | | |
|------------------------|-------|---------------------|-------|
| <i>Transverse</i> , in | ... 2 | <i>Starred</i> , in | ... 1 |
|------------------------|-------|---------------------|-------|

Direction
of rup-
tures by
falls.

In seventeen cases of *rupture by falls*, the known direction was—

| | | | | |
|--|-----|-----|-----|----|
| <i>Transverse</i> , in | ... | ... | ... | 12 |
| <i>Longitudinal, on a surface</i> , in | ... | ... | ... | 2 |
| <i>At Lower end</i> , in | ... | ... | ... | 1 |
| <i>Surface shattered</i> , in | ... | ... | ... | 2 |

Thus, in a total of twenty-five cases, caused by *falls*, Direction in total cases by falls or blows.

by *blows*, the direction was—

| | | | | |
|---|-----|-----|-----|----|
| <i>Transverse</i> , in | ... | ... | ... | 16 |
| <i>Longitudinal</i> , on a surface, in | ... | ... | ... | 3 |
| <i>On margins</i> , in | ... | ... | ... | 3 |
| <i>Starred rupture</i> , on surface, in | ... | ... | ... | 3 |

Thus we find that, in cases of *rupture* of spleen, Direction. General deductions: in all cases.

from all causes, the transverse was the direction most frequently taken by the fissure (in more than three-fifths

of the cases). When the *rupture* is the result of a

fall, or *blow* of a massive body, starred ruptures Starred fissure.

sometimes occur; they, in no case, did so, in those of

the above-mentioned cases which were caused by

blows with light bodies, such as the hand, a stick, &c.

Of the four cases in which the spleen was split, When spleen split in half, direction.

more or less, in half,—in three, the rupture was

transverse,—in one, longitudinal.

Of twenty-five cases of *rupture*, in which the direc- Longitudinal rupture.

tion of injury was known,—in three, only, was the

fissure longitudinal. Two, of these three, were on the

concave, one, on the convex, surface.

In the latter case, a single, deep, rupture nearly Three cases: 2 by falls, 1 by blow by hand.

split the spleen in two; in one of the former cases,

there were several longitudinal ruptures on the con-

cave; both of these two were caused by falls. In

the other case of longitudinal rupture on the concave

surface, the fissure was single, and non-extensive,

and was caused by blows with the hand, the stomach

being full.

Deduction. There seems no relation between the direction of the injury and, either the surface it is on, or the kind of violence by which it was caused.

All rup-
tures most
frequently
transverse. When, therefore, the injury was on one of the sur-
faces of the spleen,—in frequency of direction,
transverse was to longitudinal, as 16 to 3. What is
the reason of this ?

The causes, influencing the direction of ruptures, seem to be such as the following :—

Reasons of
direction.
Ribs—
curve of: (a.) *The force* of a blow, over the lower chest, is
transmitted, to the spleen, chiefly through the dense
ribs, and the impulse is, therefore, transmitted in
lines corresponding to the direction of slope of the ribs,
that is, a direction transverse to, or across, the spleen.

Blows are
usually
across
body. (b.) *Moreover*, blows with weapons are, probably,
more frequently delivered across the body, than in a
direction up and down it.

Shape of
spleen. (c.) *The shape* of the spleen helps to determine
the rupture in a transverse direction.

Transverse
is narrow
direction
of spleen. (d.) The transverse is the narrower, and, therefore,
weaker, diameter. The vertical length of the healthy
spleen is about 5, to 6, inches, its breadth, about 3,
to 4, inches.

Notches on
anterior
margin. (e.) The anterior margin is often notched.—
(*Quain.*) Among some hundreds of spleens which the
writer has examined, in performing *post mortem*
examinations, in India, the greater number had from
three, to five, notches, more or less deep, on anterior
margin.

This conformation, probably, tends to weaken the resisting power of the spleen in this direction, and to facilitate transverse rupture.

(*f.*) Moreover “the concave (inner) face is divided into two unequal portions, or surfaces, one anterior and larger, one posterior and smaller, which meet at a longitudinal (vertical) fissure, called the hilus, or fissure of the spleen.”—(*Quain's Anatomy.*)

This fissure of the spleen may tend to weaken the resisting power of that surface (concave), and not only tend to determine rupture to it, but cause such rupture to, most easily, run transversely, from this median fissure, to the notches on anterior margin.

Vertical
fissure on
concave,
or hilus.

Weakens
concave in
transverse
direction.

CHAPTER V.

Head III.—Stomach—The condition of, as regards distention or emptiness—As influencing the production, and nature, of injuries of the spleen.

General
remarks.

A. General observations.—Much has already been said, casually, on this subject, in discussing the causes determining the site, and extent, of injuries of the spleen.

For the sake of clearness, allusion must, here, again be made to certain details.

Relations
of surfaces
of spleen.

It has been shown that the spleen is a body lying, externally, against the left lower ribs, and the parietes of the abdomen (in enlarged state), having its large external surface adapted to their shape, and, therefore, convex ; while its internal surface is somewhat concave, and is applied to the cardiac end of the stomach.

Greatest
weakness
from sur-
face to
surface.

The direction of greatest weakness of resistance of the spleen, is from surface to surface, through its thin substance. Moreover, from the great extent to which the large external surface is in contact with the parietes, a great proportion of the impetus of external violence must impinge on this surface, and be transmitted, through the thin substance of the spleen, to its large internal, gastric, surface.

In determining the nature of the injury (if any) which the spleen may suffer from such violence, it will be seen how important a factor will be the condition of hardness, or elasticity, of the body in contact with its large internal surface.

The spleen, when enlarged, increases in thickness, and, therefore, is brought more closely in contact with the stomach; while, from the increased softness and friability usually attending such enlargement, it gains nothing in strength from such increased thickness.

In the case of such a spleen being driven inwards, by some severe external force impinging on the surface in contact with the parietes, if the concave surface meets, on its inside, with such an elastic, yielding, body as the empty stomach, the force of the blow is softened and dispersed, and the concave surface, or the whole of spleen, may escape injury; if, however, the spleen be in contact, on its large internal surface, with a distended stomach—hard and resisting as a cannon-ball—the spleen (taken, indeed, between hammer and anvil) may be shattered on its internal (concave) surface (as in Case No. 1), or on both internal and external surfaces (as in Cases Nos. 6 and 17), or through its entire substance (as in Case No. 10).

The conditions are much the same, in case the violence, impinging on some other side of the body, drive the distended stomach against the softened spleen—shut in by the ribs, on the outer side.

The elasticity or hardness of stomach, influence of:—

Enlarged spleen thickened, but not strengthened.

If spleen be driven against empty stomach,

concave surface, or all spleen, may escape.

If against hard distended stomach,

concave surface, or whole spleen, may suffer.

Full stomach driven from the other side against spleen.

TABLE IV.

Condition of Stomach, with regard to site and nature of injury to Spleen—39 Cases.

BY FALLS (19).

| | | | Case. |
|----------|------------------------|--|---------|
| Stomach. | Full in 4 ... | 1—Concave surface, spleen split almost in two ... | No. 10. |
| | | 1—Concave surface, bruise, 2" x 3" | „ 38. |
| | | 1—Concave, two ruptures,—and Convex, three ruptures = 5 ruptures ... | „ 17. |
| | | 1—Concave, two ruptures—one starred ... | „ 39. |
| | Empty in 2 ... | 1—Convex surface, and posterior margin } Shattered, | „ 8. |
| | | 1—Convex surface, rupture, 1 inch long, $\frac{1}{3}$ inch deep ... | „ 14. |
| | Not recorded in 13 ... | { 2 cases, spleen divided in half. 6 ditto, multiple ruptures. 5 ditto, single ruptures. | |

BY BLOWS (16).

| | | | |
|----------|-----------------------|---|--------|
| Stomach. | Full in 4 ... | 1—Concave surface, rupture single, by the hand, $2\frac{1}{2}$ inch long, $\frac{3}{4}$ inch deep ... | No. 1. |
| | | 1—Concave, two ruptures; convex, one ... | „ 6. |
| | | 1—Anterior edge ... | „ 16. |
| | | 1—Spleen substance shattered, capsule intact (Class II.) ... | „ 35. |
| | Empty in 3 ... | 1—Concave, star-shaped rupture, $1\frac{1}{2}$ inch long, $\frac{1}{3}$ inch deep ... | „ 15. |
| | | 2—Bruises two, convex ... | 33-34. |
| | Not recorded in 9 ... | { 4—Single rupture cases. 1—Multiple rupture case. 3—Nature not recorded. Rupture. 1—Bruise. | |

BY OTHER VIOLENCE (4).

| | | | |
|---------|-----|--|-------------------------------------|
| 4 Cases | ... | { Two gun-shot cases One tiger-wound case One—mode unknown } | Condition of Stomach not important. |
|---------|-----|--|-------------------------------------|

When the distended stomach, and the enlarged Result the same. spleen, are brought into violent collision, if either give way, it is, almost invariably the spleen, as in the cases noted below (Nos. 1, 6, 17, &c.) When, however, a spleen, healthy and firm, is brought into If spleen soft, &c., it alone may suffer. collision with a distended stomach, the coats of the stomach, though healthy, may give way at the place where they are taken between the hard mass of food, on the inside, and the firm spleen, on the outside.

Such a case (No. 38, *Shombaroo*) came under the Cases. writer's notice, on 29th August, 1879.

The stomach was ruptured, in two places, where in Case No. 38: illustrating rupture of stomach against a firm spleen. contact with spleen. The coats of the stomach were not diseased, or ulcerated, and were as thick at the margins of the ruptures as elsewhere. The spleen was firm and healthy; it was bruised, only, on its inner surface. The injury resulted from a fall from a platform, 8 feet 3 inches high, to the ground; the left side of abdomen struck on a blunt bamboo stump.

When a rupturable body, resting against an elastic Mechanical laws of rupture. medium on one side, be struck, with fracturing force, on the other side, it follows, from mechanical laws, that rupture tends to take place at the region on which the force of the blow directly impinges; when, however, there is a hard body on the other side, both sides tend to suffer. Hence, in ruptures of Thus in violence to spleen:—if stomach empty, the spleen, from external violence, when the stomach is empty, the rupture is commonly on

convex suffers ; the convex (external) surface ; but, when the spleen has been driven against a full stomach, the convex surface may still be ruptured by direct violence, but if stomach full, the concave surface, also, is usually split, or shattered, on the hard stomach. This is illustrated in the above Table IV.

Total cases, *Thus*, of 13 cases of injury to the spleen from Which surface, falls, or blows, in which the condition of the stomach when stomach full? was recorded :—

In eight, this viscus was *full*.

Of these, in 6, the *concave* suffered (with convex in 2) ; in 1, the *anterior* margin suffered.

When stomach empty? In 5, the stomach was *empty*.

Proportion concave to convex. Of these, in 3, (probably 4), the *convex* suffered (with posterior edge in 1) ; in one, the concave.

Thus, in cases of injury to the spleen—

Stomach full. when stomach was *full*,
the concave (of spleen) suffered in $\frac{3}{4}$ ths of the cases,

the convex, with concave, in $\frac{1}{4}$ th of the cases,
the convex only, in none.

Do. do. empty. When stomach was *empty*,
the concave suffered in $\frac{1}{5}$ th cases.
the convex, in $\frac{3}{5}$ ths, or $\frac{4}{5}$ ths, cases.

Ratio concave—convex. When, therefore, stomach was hard, and distended, the injury to the spleen was on the concave surface (*i. e.*, the one in contact with stomach), in a far greater proportion of cases, than it was on the convex (external) surface.

When stomach was *full*,

Stomach
full.

frequency of injury } was to { frequency of in-
to concave } jury to convex } as 3 to 1.

When stomach was *empty*,

Do. do.
empty.

frequency of injury } was to { frequency of in-
to concave } jury to convex } as 1 to 4.

Further,

frequency of injury } was to { frequency of in-
to concave, when } jury in the same } as 4 to 1
stomach *full* } surface, when } nearly. Stomach
concave
to convex.

We see that injury to the concave surface was Conclusion.
nearly four times as frequent, in occurrence, when
the stomach was full, as it was when that viscus was
empty.

The inference seems justifiable, that the hard, Full
distended, condition of the stomach was, frequently, stomach
the cause which determined the injury to the concave caused
surface of spleen. injury to
concave.

Later on, in the present chapter, it will be advanced. Do. do.
ed, that the condition of hardness and distention of primary
the stomach was, in several instances, the cause why cause of
the spleen suffered any injury whatsoever. injury.

Of 35 cases of injury to spleen, by falls, or
blows, the state of the stomach is recorded in 13,
only.

Of these 13 cases { 3 were bruises.
1 rupture, Class II.
9 ruptures, Class III.

Of the 3 cases of *bruise*,—in two, the stomach was Bruises :—
empty, and the injury was on the convex,—certainly, in surface,
On which

and state
of stomach?

one case—probably, in the other, (this last case lived, and there was, therefore, no *post mortem* examination). In the third case, the stomach was *full*, and the bruise was found on the concave, on dissection.

One rup-
ture,
Class II:—
Stomach
full,
caused the
injury.

In the one case (No. 35) of *rupture*—under Class II—the stomach was gorged with rice—the enlarged, softened, spleen was crushed, between the hard stomach, and the parallel bars, at the gymnasium; the spleen-substance was shattered to pieces, though the capsule, thick and tough as leather, remained entire. Four days after the injury, the capsule gave way, from distention, and softening; and the man instantly died—(*vide* Chapter III).

Of 9 cases
rupture in
Class
III:—

Of 9 cases of *rupture* of the spleen, under Class III, in which the state of the stomach is recorded, the stomach was *distended*, in 6,—*empty*, in 3.

Stomach
full,

Of these 6 cases in which stomach was *full*, in 5 the concave suffered, *viz.* :—

Region
which
suffered.

In 3, concave only.

In 2, concave, with convex.

In 1, anterior edge only, suffered.

And the
nature of
violence.

Of the 3 cases in which concave only, suffered, the cause was :—in one, a fall from a tree; in one, blows with the hand; in the third case, a fall while stepping over a shallow ditch.

Of the 2 cases in which concave, and convex, suffered, the cause was :—in one, fall from a tree; in one, a blow with a heavy wooden-mallet.

Of the 3 cases of *rupture* of spleen in which stomach was *empty*—the injury was :—

in 2, on convex, *viz.* :—

{ in 1, on convex only,

{ in 1, on convex, and posterior edge,

(both these being caused by fall)

in 1, on concave—(caused by pounding).

Resumé.—Thus, in injuries (whether *ruptures*, or *bruises*) to the spleen, by either *falls*, or *blows*, the concave usually suffers if stomach be *full*,—the convex, if stomach be *empty*.

In the only case of *bruise* caused by *fall*, the firm, healthy, spleen escaped all injury on the side next the blow, and did not suffer from contre-coup, but was bruised, on its concave surface, against a full stomach. Had the spleen impinged on an elastic, empty, stomach, internally, it would, probably, have escaped all injury.

Appended, are brief notes of thirteen cases in which the state of the stomach was satisfactorily recorded :—

| | | | |
|-----------------------------|---|--------------------------------|-------|
| A. <i>Stomach full in</i> 8 | { | Injury on concave (one bruise) | 4 |
| | | Do. on concave, and convex | 2 |
| | | Do. on anterior | ... 1 |
| | | Rupture, Class II ... | ... 1 |

1. *Case No. 10*—*Bhokaroo Konch*, æt. 35—

Injured by fall from a tree;—stomach, distended with a mass of rice;—spleen, large and soft, split almost in two, by a transverse fissure, from concave side;—survived, for three hours. There was a small rupture, and severe congestion, of left lung.

Stomach empty.

Injury on convex, &c.

Rarely on concave.

General deduction.

Only one case of bruise by fall; in this a full stomach determined the injury.

Case No. 10 :—

Stomach distended; spleen split in two transversely.

2. *Case No. 17—Dorma Kolita, æt. 28—*

Case No. 17: Stomach distended; spleen soft, ruptured on both surfaces.

Injured by fall from a tree;—stomach, distended;—spleen, large and soft, was ruptured, extensively, in five places,—two, on concave,—three, on convex, one of these last being right across, and half way through, the spleen;—survived, for half an hour. There was superficial congestion of both lungs.

3. *Case No. 1—Kanda Thakor, æt. 23—*

Case No. 1: Stomach distended; spleen ruptured on concave.

Injured by blows with the hand;—stomach, distended;—spleen somewhat enlarged, but firm, was ruptured, on concave; injury, $2\frac{1}{2}$ inches long, $\frac{3}{4}$ inch deep. The colon suffered rupture where the lower end of spleen rested against it, *viz.*, the angle of junction of transverse and descending colon;—survived, for half an hour.

4. *Case No. 6—Myadhur Kolitani, æt. 20—*

Case No. 6: Stomach distended; spleen firm, ruptured on both surfaces.

Hindoo woman—injured by a violent blow with a heavy, wooden-mallet;—stomach was distended;—spleen, not large, or soft—healthy—was ruptured, in three places—two, on concave, one, on convex—each rupture, on concave, was, from 2 inches, to 3 inches, long, and from $\frac{1}{4}$ inch, to $\frac{1}{2}$ inch, deep; the one on the convex was transverse, 3 inches long, $\frac{1}{2}$ inch deep. Death was immediate.

5. *Case No. 16—Poorma Ram, æt. 35—*

Case No. 16.

Injured by blow with back of a dhao;—stomach, full of rice;—spleen, very large and soft—ruptured down the anterior edge. The spleen resembled a mere bag of blood.

6. *Case No. 38—Shombaroo Sheikh, æt. 19—*

Fell from a platform, 8ft. 3in. high, on to left side, which struck against a projecting, blunt, bamboo stump;—stomach, distended, at the time, and found so, on dissection;—*spleen*—firm and healthy—bruised, on concave surface, to extent of 3in. \times 2in., and $\frac{1}{3}$ in. deep;—stomach, distended; at cardiac end, where in contact with spleen, were two ruptures through all its coats—no sign of disease, or ulceration, of the coats of stomach. Had the spleen come into contact, internally, with an empty, elastic, stomach, the concave surface would, probably, have escaped this crushing, just as the external surface escaped all injury from the direct shock of the blow;—survived, for seven hours.

Case No. 38:—
Stomach distended and healthy, ruptured against firm spleen by fall; spleen only bruised on surface of contact.

7. *Case No. 35—Chunkea Soobha, æt. 32—*

Injured by slipping in the gymnasium, while exercising on the parallel bars; the left side of body struck the left bar;—stomach, distended with a mass of rice. The soft, large, spleen had its substance shattered, though the capsule—thick and tough as leather—remained intact.

Case No. 35:—
Stomach distended; spleen large, shattered inside its intact capsule.

On the fourth day, the capsule ruptured, and immediate death followed.

8. *Case No. 39—Khedala, æt. 54—*

Injured by falling to the ground, while crossing a shallow ditch;—stomach, full of rice;—spleen, large and soft; ruptured, in two places, on concave surface; one rupture is starred, in the region posterior to the hilus;—survived, for half an hour.

Case No. 39:—
Stomach full; spleen had ruptures on concave.

Cases,—
Stomach
empty;
region of
injury
of spleen.

B. Stomach empty in { *Convex, in* ... 3
5 cases—Injury on { (probably 4).
(with *post. margin* in one.)
{ *Concave, in* ... 1

9. *Case No. 8—Jurmu Ram, æt. 13—*

Case No.
8:—Sto-
mach emp-
ty; spleen
shattered
on convex.

Injured by a fall from a tree ;—stomach empty ;—spleen, large and soft ; its convex surface, and posterior edge, shattered. Death was almost immediate.

10. *Case No. 14—Woochem Garo, æt. 30—*

Case No.
14:—Sto-
mach emp-
ty; spleen,
firm, rup-
tured on
convex.

Injured by fall from a tree ;—stomach, empty ;—spleen, slightly enlarged, but firm, had a transverse rupture on the convex surface, 1 inch long, $\frac{1}{3}$ inch deep. Both lungs were congested ; and the endocardium was pink-colored, from injection of the minute bloodvessels ;—survived, for five days..

11. *Case No. 15—Polton, æt. 45—*

Case No.
15:—Sto-
mach
empty;
spleen soft.

Injured by pounding with the knees, &c., and by blows with native shoes ;—spleen, enlarged, and rather soft, had a star-shaped rupture on the concave ;—stomach, empty ;—survived, for two hours.

12. *Case No. 33—Narah Koiburto, æt. 30 —*

Case No.
33:—Sto-
mach
empty;
spleen,
firm,
bruised
on convex.

Hindoo male, injured by pounding by the feet, knees, &c., of assailants. Survived, under treatment, for four days. Stomach, empty, at time of injury. The spleen was slightly enlarged, but firm ; it had a bruise, on the convex surface, 3 inches by $1\frac{1}{2}$ inch, and from $\frac{1}{3}$ to $\frac{1}{2}$ inch deep into the substance.

13. *Case No. 34—Mohiram, Hindoo male, æt. 39—*

Case No.
34:—Sto-

Injured by pounding with feet, and hands, of assail-

ants. All the symptoms pointed to a bruise of convex surface of the slightly enlarged, but firm, spleen. The stomach was empty, at the time of injury. The case recovered in eighteen days, and the injury could not be verified by dissection.

Resumé.—It will be noticed how extensive and multiple the injuries were in cases in which the stomach was full and the violence was of a severe nature. Thus, in the three cases of ruptures, produced by falls, when stomach was full (Cases Nos. 10, 17, and 39), in one, the spleen was split into two portions; in the second, it was ruptured in five places; in the third, it had two ruptures—one, extensive, and starred. In the case (No. 6), in which the crushing-blow from a heavy mallet caused the injury, the spleen was ruptured in three places, though it was not enlarged or soft.

In Case No. 1, though the injury was inflicted by blows with the weaponless hand, and the spleen was firm, though slightly enlarged, yet the concave surface suffered rupture, $2\frac{1}{2}$ in. long, and $\frac{3}{4}$ in. deep; the severity of the rupture, apparently, being chiefly due to the presence of the distended stomach.

It will be observed, in the six cases in which rupture of spleen (Class III) took place while the stomach was full, that, in one case only, did the surface of spleen in contact with the hard stomach escape. In this instance, the spleen was distended into a mere bag of blood, extremely soft and capable

mach
empty;
bruise of
spleen.

Resumé.
Note, when
stomach
distended
and the
violence se-
vere, injury
results
multiple
and exten-
sive.

If stomach
distended,
slight
violence
may rup-
ture a firm
spleen.

Cases in
which sto-
mach dis-
tended=6.
In five the
concave
suffered; in
only one it
escaped.

of rupture—it was struck with a light weapon, and there took place immediate rupture of the region on which the blow directly impinged. The full stomach seems to have had no determining influence, in this case.

Distended
stomach
causing
injury.

In Case No. 38, the firm, healthy, spleen entirely escaped injury from the direct blow (on convex), and from contre-coup. It was, probably, solely due to the hard, full, stomach, on its inside, that the bruise, on concave, was suffered.

Contrast
Case No.
33.

Case No. 33 is in contrast to the above ; in this instance, the stomach was empty ; and severe pounding, with knees, &c., produced bruise, only, of the convex,—the concave entirely escaping injury.

Compare
Case No. 8,
in which
concave es-
caped.

It will be noticed, too, that, in Case No. 8, though the violence was severe enough to shatter the convex surface and the posterior edge, yet, as the concave surface rested against an empty, elastic, stomach, it entirely escaped.

Case No.
14, com-
pare.

In Case No. 14, the violence was severe enough to cause congestion of both lungs, and endocarditis. The coincidence, will be noticed, of an empty (elastic) stomach, with entire escape of the concave surface of the spleen, and only a very slight injury—one inch long, one-third inch deep—on convex surface.

Cases Nos.
10 and 39.
From Fall.
Only the
surface in
contact
with full
stomach
injured.

It will be observed, too, in Cases, Nos. 10 and 39, that though the violence to the body was of the diffuse nature resulting from a fall, in each case, yet every region of the spleen escaped injury, except the surface (concave) in contact with the distended, inelas-

tic, stomach ; this latter surface receiving very extensive injuries, in each case.

Frequency of injury to other viscera, in cases of injury (by blows, or falls) to spleen, when stomach is full.

Stomach full, in 8 cases—in which, injury to other viscera occurred, in 4. In half the cases when stomach full.

Stomach empty, in 5 cases—in which, injury to other viscera occurred, in 1, only. In $\frac{1}{5}$ th of cases when stomach empty.

**Stomach*—condition not recorded, in 22 cases; in which, injury to other viscera occurred, in 6.

It will be noted how much more frequent was injury of other viscera, when stomach was full, than when it was empty. Deduction.

When the stomach was full, these injuries occurred in one-half of the cases ; when stomach was certainly empty, in $\frac{1}{5}$ th of the cases ; in other instances, in which condition of stomach was not recorded, they occurred in $\frac{3}{11}$ th, only, of the cases. The proportion stands :—cases—stomach full : ditto condition not known : ditto empty—as 11 : 6 : 4 $\frac{2}{5}$, respectively, in these three classes of cases. It is seen, then, that injuries of other viscera occurred, with markedly greater frequency, in cases in which the stomach was distended, than they did in cases in which this viscus was empty. Proportion of cases.

Cases of injury to other viscera, when the stomach was distended.

* The two cases of injury to spleen by gunshot (Nos. 11, and 12) are omitted, as not concerning the point under discussion.

Case of
stomach
itself being
ruptured.

In one case, No. 38, in which stomach was full, it was itself ruptured, in two places, at the region where it lay in contact with the spleen ; its distended

Its disten-
tion was
the main
cause.

condition seems to have been, entirely, the cause of these ruptures, for it is scarcely possible that the stomach, in its elastic, yielding, empty, state, should be ruptured against the contiguous smooth surface of the spleen.

Case of
congestion
of both
lungs.

Cases of
congestion
of left
lung.

Case of
rupture of
colon
where
spleen rest-
ed on it.

In another case, No. 17, both lungs were congested ; in a third, No. 10, there was rupture and congestion of the left lung ; in the fourth case (No. 1), there was rupture of the colon, at angle of junction of transverse and descending portion. It is highly probable that the distended state of stomach was a factor in producing this latter injury—the impulse of the spleen, inwards, being suddenly checked by the hard body on its inside, would be transmitted, upwards, and downwards, to the two ends, and, thus, the lower, pointed, end would be brought into sudden collision with the region of colon in which the rupture occurred.

Distention
of stomach
tends to
cause in-
jury to
other
viscera.

It will be noted, too, that, in both cases in which the other injured viscus was an abdominal one, the stomach—in its distended condition—seemed to be the main influence in determining the occurrence of this injury. Thus, a distended stomach increases the risk to the contiguous abdominal viscera. In cases in which the other viscera injured were the lungs, the condition of the stomach, as might be imagined, seemed to have exerted less direct an influence.

CHAPTER VI.

Head IV.—The condition of the Spleen, as regards health, or disease, as influencing the production, and nature, of its Injuries.

The condition of spleen, as regards health, or disease, Head IV.
as influencing the production of its injuries.

In discussing this subject, it will be most convenient to consider the position, surroundings, and structure, of the spleen in its healthy state, and its departure from these conditions when in a state of disease; though, in doing this, there must be more or less repetition of what has been already said in previous chapters.

The spleen, in health.—The spleen, in health, is a Spleen in health. compressed, oval, body, having two faces; one, external, convex, and free, turned to the left, and protected by the cartilages of the left lower ribs; the other, Surroundings. internal, directed to the right, and applied to the External face. cardiac end of the stomach, and, therefore, concave. The border, or circumference, resulting from the Internal face. junction of these faces, may be considered as forming an anterior, and a posterior, margin, and an upper, and a lower, end. The anterior margin is thin, and Anterior margin.

Posterior margin. applied to the stomach ; the posterior margin, and upper end, are thick and rounded, and rest against the left kidney, and the diaphragm ; the lower end is pointed, and is in contact with the angle of junction of transverse and descending colon.

Upper end.
Lower end.
Size in health. No organ varies so much, in size, in different individuals, or, at different times, in the same individual. It, ordinarily, weighs 5oz., to 7oz., and is elastic, and distensible. It becomes turgid, and enlarged, after a meal, during digestion. In health, it is elastic, but firm, and is covered by a smooth elastic capsule of serous and fibrous tissue.

After meals becomes turgid.

(Much of the above is from Quain's Anatomy.)

In the present papers, we have only to do with those alterations which the spleen undergoes from fevers (ague) and malaria.

In fevers enlarged, and from malaria, chronic enlargement. In intermittent and other fevers, it becomes distended and enlarged, and, in malarial regions, where the people suffer much from ague, and from a depraved state of health known as malarial cachexia, the spleen, commonly, undergoes chronic enlargement, to a great extent.

Weights of spleen in the present cases.

From 5oz. to 7oz. (in health), it, sometimes, attains a weight of 18, to 20, pounds, and has been known to weigh 40 pounds. Among the present cases, we find records of the spleen weighing :—44 ounces, in Case No. 24 ; 30 ounces, in Case No. 23 ; 28 ounces, in two cases—one, in a boy, aged 15 years (Case No. 27)—one, in a child, aged 12 years (Case No. 18). This

malarially-enlarged condition of the spleen is known as "ague-cake."

The smallest spleen the writer has ever met with, Case of extremely small spleen in a malarial cachectic. was in a dissection, made on 28th September, 1879, of the body of one Banchit Ghose. It was 3 inches long, 2 inches wide, but very flat and thin, being only one-third of an inch in thickness.

It was of a black-violet color, and extremely soft. Its weight was—one ounce and nineteen grains. It was uninjured. The capsule was extremely thin and diaphanous.

Its softness, and dark state of pigmentation, were, perhaps, due to malarial changes; the man lived in a notably malarious region.

To whatever cause the pigmentary degeneration may have been due, the fact remains, that this extremely atrophied state of the spleen occurred in a malarial cachectic—such a condition of the spleen being the reverse of what usually obtains among these. Atrophy of spleen rare in malarial cachectic.

With this enlargement in size, the spleen undergoes alterations in consistency. From being firm and elastic, its substance becomes soft or friable, often pulpy, inside the capsule; sometimes to such an extent that the viscus resembles a soft bag of blood. Alterations in substance and consistency.

It is rare to meet with a malarially-enlarged spleen that has remained firm. The enlarged spleen sometimes has the consistency of a soft blood clot; it is then friable, and easily broken down. Extent of softening. Friable spleen.

Alterations
in capsule.

In cases of malarial enlargement of the spleen, its capsule, ordinarily, becomes more or less thickened and opaque, from increase of white fibrous tissue; but, usually, not enough so to afford increase of protection at all proportionate to the increase of the spleen in size and softness.

Capsule
sometime
enor-
mously
thick.

But, occasionally, from exaggeration of the chronic inflammatory process producing the thickening, the capsule of the enlarged spleen becomes enormously hypertrophied, by increase of white fibrous tissue, into a dense, white, covering as thick and tough as chamois leather (as in Case No. 35).

Site, chan-
ges of.

When the spleen undergoes this process of enlargement, it, necessarily, undergoes alterations in its situation and surroundings.

Extends in
which di-
rection:
ribs limit
it outside;
stomach,
when full,
on inside.

It is enclosed, on several sides, by bodies which do not permit of much permanent enlargement taking place in their direction; on the outer side, the ribs; on inner side, the stomach. The custom, among natives, of eating at long intervals, and of, mainly, consuming rice and other farinaceous food, has necessitated the habit of eating large quantities at a time, commonly two full pounds of rice at a meal. The stomach, in this state of repletion, is hard and unyielding as a cannon-ball.

Spine and
kidney
limit it
behind.

The enlarging spleen, therefore, limited, by ribs, on the outside, and by the stomach, distended at regular intervals, on the inner side, cannot enlarge, indefinitely, in these directions.

No great extension backwards can take place, as, here, the kidney and spine oppose a limit.

Nor, probably, can much permanent extension take place upwards ; as the diaphragm—intermittingly tense in respiration—tends to keep the spleen pressed down.

To a certain extent, it does encroach, in all these directions, and is, therefore, more closely embraced by all these surroundings, than when in health.

The chief direction, then, in which the enlarging spleen is free to extend, is the downward one ; the intestines, elastic and mobile, are easily thrust aside.

Thus, the enlarging spleen, limited in other directions, and aided, by gravity, in this one, encroaches on the space of the abdominal cavity.

In doing so, it leaves the protection of the left lower ribs, and has, external to it, only the muscular walls of the abdomen.

In moderate degrees of enlargement, the spleen is to be felt below the lower left ribs ; it, often, extends to a level with the umbilicus ; the writer has seen it occupying most of the abdominal cavity, and reaching down to the pubes, strongly resembling the gravid uterus at its largest.

This state of enlargement of the spleen results, indirectly, from a permanent dilatation of its vessels, constituting a form of chronic congestion, or low inflammation ; this leads to an excessive formation of the true spleen-substance, which, being of a soft, pulpy,

nature, causes such enlargement to be accompanied by a softened condition of the gland—the more so, as the chief increase, causing enlargement, takes place in the amount of this spleen-pulp, and not in the firm, fibrous, frame-work of the viscus.

Fluid exudations—
extreme
softness.

When fluid, congestive, exudations, from the hyperæmic vessels, mix with the increased spleen-pulp—the viscus assumes the very soft condition, and is, aptly, described as resembling a bag of blood.

When semi-
organizable
lymph ex-
uded into
the pulp—
friable
spleen.

Occasionally, exudation of semi-organizable, inflammatory, lymph takes place into the increased spleen-pulp, and, there, undergoes a feeble coagulation—causing the whole to cake together into a hard, but easily broken down, mass ; constituting the form of enlargement known as the *friable*.

Protection
enjoyed
by healthy
spleen.

Protection from injury.—The healthy spleen—small in size, firm and elastic in structure, lying well behind the lower ribs, and protected on every side—is little liable to injury, and, as a point of fact, commonly escapes being hurt, even in cases in which very severe violence has been applied over its region. In illustration of this point, see Case No. 38, Shombaroo, later on.

Protection
from injury
in disease.

In the state of disease, described above, all the conditions of the spleen, as regards liability to injury, are changed.

It leaves
the protec-
tion of the
ribs.

In place of a firm, elastic, body, we have a soft, or friable, often pulpy, one ; instead of a small body, protected behind the ribs, and loosely connected to

its surroundings, we have one, enlarged, descending below the protection of the lower ribs, encroaching in every direction, and thus embraced with dangerous firmness by its hard surroundings ; which last, thus, instead of continuing to contribute to its security, become sources of risk.

Its protections in health become its dangers in disease.

Consequently, the conditions which are its special protection, in health, become its special dangers, when it is diseased.

Moreover, the thickening of the capsule, to the degree ordinarily accompanying enlargement of the spleen, though sufficient to hold together the friable, pulpy, spleen-substance, is rarely sufficient to efficiently protect the softened viscus. Even when the thickening of the capsule has advanced to the stage of furnishing a tough, leather-like, covering to the viscus, the spleen-substance may, still, be ruptured inside, while this containing capsule is intact—as in Case No. 35. In cases of less degree of violence, perhaps such a tough capsule might tend to prevent injury to the spleen-substance. In Case No. 35, this leathery capsule, remaining intact, caused the patient, for four days, to survive ruptures of the spleen-substance so extensive that they must have been immediately fatal had the capsule suffered equally with the spleen-substance, at the time.

Thickened capsule, little protection.

Prolonged survival in Case No. 35 due to thickened capsule.

Under the conditions noted above, it will be seen how very liable to injury is the diseased spleen.

Where it projects into the abdomen, only protected

Direct injury

through
abdominal
walls.

by the thin plane of the abdominal walls, it is liable to injury—direct, or by contre-coup—from blows impinging on its surface, through the abdominal walls.

Soft spleen
crushed
against
hard sur-
roundings,
in disease.

Moreover, from its generally enlarged state, it is held in an abnormally close grip by the hard bodies surrounding it on certain sides ; and, in its soft, or friable, condition, its contact with these hard bodies (spine, ribs, kidney, periodically distended stomach) entails, on the spleen, great risk of rupture, should any external force bring it into sharp contact with any of these hard bodies, or compress it between them.

General
conclusion.

General conclusion.—The state of health, or of disease, of the spleen, is a most powerful factor in determining its liability to injury.

In diseased
state, is
very liable
to injury.

The healthy spleen, in its small, firm, state, is well-protected from injury, and rarely suffers any.

Whilst that viscus, in its enlarged, diseased, state, is peculiarly liable to suffer, on the occasion of any violence to the body ; and, as a matter of fact, frequently does so suffer.

Proportion
of cases of
healthy and
of diseased
spleens
injured.

It will be seen, below, that in the thirty-nine cases, on which these papers are founded, the proportion of known healthy, to diseased, spleens, stands :—

| | | | | |
|----------------------------|-----|-----|----|----------|
| Healthy spleens injured in | ... | ... | 3 | } cases. |
| Diseased spleens | ... | ... | 29 | |

Of 39 cases,
in 32 the
known
condition

In the thirty-nine cases of injury to the spleen, in three the condition of the viscus had no influence in

the production of the injury, *viz.*:—in two gunshot cases, and in one, injured by a tiger.

of spleen
was a factor
in the
causation
of injury.

In four others, the condition of the viscus, as regards health or disease, was not definitely recorded.

The thirty-two remaining ones were cases in which the known condition of the spleen influenced the nature, or production, of the injury.

Table V, shows the condition of the spleen, in these thirty-two cases, grouped under heads of falls, or blows, according to the cause of their production.

TABLE V.

Known condition of the spleen, in thirty-two cases of its injury, by falls, or blows.

| Violence by | Spleen very large and soft. | Spleen large and soft. | Spleen enlarged, but firm. | Spleen healthy. |
|----------------|--|---|---|--------------------|
| Falls ... | <div>No. 18 19 20 28 32 23 31</div> <div>{ Injury Multiple or Extensive } 5... {</div> <div>{ Single } ... 1 ... {</div> <div>{ * Other } ... 1 ... {</div> <div>7</div> | <div>No. 17 21 8 10 39 3 5</div> <div>{ Injury Multiple or Extensive } 5... {</div> <div>{ Single } ... 2... {</div> <div>7</div> | <div>Rupture. 1 (No. 14). (Lung and Heart injured.)</div> <div>2 {</div> <div>{ 1 Rupture (both lungs injured). } 13</div> <div>{ 1 Bruise (stomach ruptured.) } 38</div> | |
| Blows ... | <div>No. 4 27 31 16 7</div> <div>{ Injury Multiple or Extensive } 3... {</div> <div>{ Single } ... 2... {</div> <div>5</div> | <div>No. 15 24 35 36 2</div> <div>{ Multiple or Extensive } 4... {</div> <div>{ Single } ... 1... {</div> <div>5</div> | <div>No. 1 (No. 6.) by blow with mallet. (Stomach full.)</div> <div>Rupture.</div> <div>3 { 1 Rupture (Colon ruptured also) } 1</div> <div>2 { Bruises ... } 33 34</div> | |
| Fall or Blow | 1 Single ... No. 29 | | | |
| Total ... | 13 | 12 | 4 | 3 |

* Exact nature of the injury not recorded.

From the above Table V, it is seen that of thirty-two cases of injury to spleen :—

In twenty-five, there was a *very, or somewhat*, In large and soft spleens the injury always *enlarged and soft* condition of spleen; in all these, the rupture. injury was *rupture*, and, usually, it was severe and extensive.

In four cases, the spleen was *firm, though somewhat* In firm spleens injury in two bruise in two rupture. *enlarged*; in two of these, only, was the injury, to the spleen, *rupture*; in the other two, the injury was a *bruise*.

In only three cases, was a *healthy* spleen injured; and, in each of these three cases, the violence causing the injury was severe, and the case exceptional. Thus, in Case No. 6, the injured person received, over the region of the spleen, a blow, with a heavy wooden-mallet, sufficiently severe to have ruptured the spleen Three healthy spleens injured by great violence; and exceptional conditions. had it been of iron, as the stomach was full, and spleen Cases : In No. 6 caused by a heavy blow with a massive mallet. was shattered against it.

In the other two cases, the extreme nature of the The other two cases. violence is shown by the injuries which other viscera suffered: in Case No. 38, the distended stomach suffered double rupture, on the face of contact with the spleen, this latter being bruised, only; in Case No. 13, both lungs were bruised and congested.

In twenty-five cases the spleen was *very, or moderately, large, and soft.* In 25 cases, spleen large and soft.

In two of these, the spleen was like a mere bag of blood, in consistency, and needed but slight violence In 2 cases spleen was like a mere

“bag of blood.”

to cause rupture. In both, the injury was caused by blows with a non-massive body.

Cases,
No. 16.

a.—Case No. 16, Poorna Ram.—A blow, with the back of a dhao,* caused rupture down the anterior margin. Spleen resembled a bag of blood.

No. 31.

b.—In case No. 31, Goomaroo, the injury was inflicted with a bamboo stick. Spleen, a mere bag of blood.

In 4 cases,
spleen
split in two.

In four of the cases noted in the above Table V, the spleen was split more or less in two, *viz.* :—

Case No.
24: Large,
soft, spleen
split trans-
versely,
by blow
with yoke
of plough.

a.—Case No. 24, Doosaram, ætat 20, struck by yoke of a native plough, as the oxen bolted. The large and soft spleen was split, transversely, in two, from both surfaces—a few trabeculæ, in the centre, alone connecting the halves. After being washed, the spleen weighed 44 ounces. No other viscera injured. The large, soft, condition of the spleen seems to have determined the extent of the injury.

Spleen
44 oz.

Case No.
28.

b.—Case No. 28, Obi Ram ; spleen was very large and soft ; it was split in two, transversely, by fall from a tree. No other viscera injured.

Case No.
10.

c.—Case No. 10, Bhakaroo ; from a fall, the large, soft, spleen was split almost in two, transversely, from the concave surface. Stomach was full. The left lung was ruptured and severely congested.

Case No.
30: Spleen
split al-
most in
two—by
fall.

d.—Case No. 30, Kola Show ; by a fall from a tree, the spleen was split, longitudinally, from upper to lower end of convex surface ; the fissure was deep, and gaped wide ; it almost divided the spleen in two.

* A dhao is a kind of chopper, or bill, heavy and elongated.

Many ribs, on both sides of body, were broken. Both lungs were pierced by the fractured ends of these ribs.

It will be noticed that, in Case No. 28, the spleen was very large and soft, and a degree of force, which failed to injure any other viscera, was sufficient to split that viscus in two.

More cases are detailed, under Head 2, in Chapter IV (Nature, and degree, of the rupturing violence), which further illustrate this point.

A.—*Very large and soft* spleens were ruptured, in Very large and soft spleens. thirteen cases :—

| | | | | |
|-----------------|-----|-----|-----|---|
| By falls | ... | ... | ... | 7 |
| „ blows | ... | ... | ... | 5 |
| „ fall, or blow | ... | ... | ... | 1 |

Of the seven cases, by *falls*—

in 5, the rupture was multiple, or extensive ;

in 1, not certainly recorded ;

in 1 case, single and slight.

Falls.

Blows.

Injury,
multiple or
single.

Of the five cases, by *blows*—

in 3, the rupture was multiple, or extensive,

in 2, single and slight.

Proportion
of each.

B.—*Moderately large and soft* spleens suffered *rup-* Spleen moderately large and soft. *ture* in twelve cases—

| | | | | |
|--------------|-----|-----|-----|---|
| By falls, in | ... | ... | ... | 7 |
| „ blows, in | ... | ... | ... | 5 |

Of the seven cases, by *falls*—

in 5, rupture was multiple, or extensive,

in 2, rupture was single and slight.

Multiple
or single
rupture by
falls or by
blows.

Of the five cases, by *blows*—

in 4, rupture was multiple, or extensive,

in 1, rupture was single and slight.

Total cases:
Spleen
more or
less large
and soft.

Of the total number of cases in which a spleen, more or less large and soft, was ruptured, *viz.*, twenty-five cases—

in 17, the rupture was multiple, or extensive,

in 7, the rupture was single and slight.

Multiple
or single
injury,
proportion
of.

Of these twenty-five cases:—from *falls*, were fourteen*—

of which, 10 were multiple, or extensive,

and, 3, single and slight ;

while, from *blows*, were ten—

of which, 7 were multiple, or extensive,

and, 3, single and slight.

Conclusion
in cases of
soft and
large
spleens.

Conclusion.—From the above statements it would seem that injuries to soft and enlarged spleens, are, most frequently (in 2, out of 3, roughly), multiple, or extensive ; and this extent of the injury seems to depend on the diseased state of the viscus, as a cause.

Enlarged
but firm
spleens,
only 4
injured, in
32 cases.

C.—*Enlarged but firm spleens* were injured, in four, out of the thirty-two, cases. One case was caused by a *fall* ; the spleen was ruptured. Three cases were caused by *blows* ; one by the hand—a rupture ; two by pounding by feet, knees, &c.—both were bruises.

Of these 4,
half were
bruises
only.

Thus, of these four injuries to enlarged, firm, spleens, two were ruptures, while two were bruises—a lesser form of injury.

* In one case, the nature of the rupture was not certainly known.

It will be recalled, that, in the cases of injury to soft and large spleens, in every instance, of twenty-five, the severer form of injury, *viz.*, rupture, occurred.

The case of rupture of enlarged, but firm, spleen, caused by *fall*, was No. 14.—Woochem, ætat 30. The violence of the fall seems to have been very severe; both lungs were intensely congested; and the endocardium was pink, from injection of its vessels.

Case of firm spleen only slightly injured when lung and heart suffered.

The convex surface of spleen had a small, transverse, rupture, 1 inch long, $\frac{1}{3}$ inch deep; only a few drops of blood had escaped into peritoneal cavity. The man survived, for five days; and, on dissection, the wound of spleen was found blocked up by a firm, partially-organised, clot. The injuries to heart, and lungs, were the main causes of death.

It is seen that, in this case, the firm condition of the spleen caused that it only suffered slightly, from a degree of violence sufficient to inflict such injuries, on the heart, and lungs, that these latter were the main cause of death. Only a few drops of blood were lost, and the firm spleen made a successful attempt at repair of the wound.

Conclusion in this case.

In the second case of rupture of a *firm, though enlarged*, spleen (*Case No. 1, Kandha Thakor*), the concave surface had a rupture, $2\frac{1}{2}$ inches long, $\frac{3}{4}$ inch deep, caused by *blows* with the closed hand. The violence, in this case, was sufficiently severe to cause (beyond extensive external bruising) a rupture of the colon, at the an-

The other case: Firmness enabled it to rupture the colon and escape direct injury.

gle of junction of transverse and descending portions (*i. e.*, where the lower, pointed, end of spleen was in contact with it). The firmness of the spleen seems to have saved, from rupture, its lower end, which inflicted the injury on the colon ; had the spleen been soft, probably this injury to colon would not have occurred.

Concave
split on full
stomach.

The stomach was full, and so, though the convex surface escaped injury from direct shock, the concave was split against the hard stomach.

Firm con-
dition saved
convex and
lower end.

Thus, the firmness of this spleen enabled it to resist the direct shock of the blows on the convex ; and to inflict a rupture on the colon, itself escaping at this region ; though the accident of the stomach being distended, determined a rupture, of the concave surface, against that hard viscus.

Firm con-
dition gave
the spleen
resisting
power.

It will be observed that, in the two, above detailed, cases, the firm spleen suffered only slight, single, rupture, though the violence was sufficiently severe to inflict injuries, very grave, (and mainly fatal) on other viscera—heart, lungs, colon.

These cases well illustrate the resisting power of a spleen of a fair degree of firmness ; and the first case (No. 14) demonstrates the tendency of such a spleen to healthy repair.

Two
cases of
bruising
of firm
spleen.

In the two cases of bruising of a firm, though enlarged, spleen, (Nos. 33 and 34), in both, the violence was by pounding by the feet, knees, &c., of assailants—a form of assault capable of extreme severity.

In Case No. 33, the extent of the violence was ex- Case No. 33.
 emplified by the pink ecchymosis, and the extensive
 congestion, of the left lung. The man survived, for
 four days ; dissection showed a patch of dark ecchy-
 mosis, on convex surface of the spleen, 3 inches long,
 1½ inches broad, and penetrating ½, to ⅓rd, of an inch,
 into the spleen-substance.

That, in this case, the spleen escaped, with merely
 the lesser injury of bruise, was, no doubt, due to its
 firm condition.

In the second case—No. 34—the man eventually Case No. 34.
 recovered.

In contrast to the above two cases, in which, Contrast cases in which similar violence caused rupture.
 from pounding with feet, knees, &c., the firm spleen
 suffered only bruising, may be quoted two instances,
 in which, precisely similar violence caused rupture, in
 each instance, when the spleen was soft, as well as
 enlarged.

In Case No. 15, Polton, a soft spleen suffered a Two cases.
 star-shaped rupture, on the concave surface, though
 the stomach was empty, and yielding.

In Case No. 25—Budoo Kouch—the soft spleen Spleen soft.
 was ruptured.

Both men had been pounded, by the feet, knees, Pounding.
 &c., of assailants.

These two contrasted pairs of cases well illustrate In one pair of cases, spleen soft,—ruptured.
 the different behaviour of the firm spleen, and of the
 softened spleen, under similar conditions of the same
 violence.

In other
pair, spleen
firm—
bruises.

In none, of the four cases, was the stomach full ; so that, apparently, the two pairs of cases differed in one sole condition, *viz.*, the firmness, or softness, of the spleen.

We may, therefore, conclude that this was the condition which decided whether mere bruising, or distinct rupture, should occur.

Healthy
spleens
injured in
only 3 out
of 32 cases.

D.—Healthy spleens.—Table V shows that, of thirty-two cases of injury to spleens, in three, only, were *healthy spleens* the subject of such injury.

Of twenty-five cases, in which *large and soft* spleens suffered injury, in every instance it took the severer form of *rupture*.

2 rupture,
1 bruise.

Of three cases, of injury to *healthy* spleen—two, were *ruptures*—one, was *bruise*.

Two were caused by falls ; one, by a blow.

Case No.
13: Rupture
of healthy
spleen.

Case No. 13, Heho Kolita, ætat 13, injured by fall from a tree.—The healthy spleen sustained a rupture across the convex surface, 4 inches long, $\frac{1}{3}$ inch deep. There were extensive bruises among the muscles of chest and abdomen.

Extensive
bruising of
both lungs.

Both lungs showed marks of severe bruising ; they were of a scarlet color, on their anterior surfaces, and much congested, in their deeper portions. Condition of stomach, not recorded.

Violence
severe.
Proofs.

From the extent of the bruises among the external tissues, and the injury to the lungs, it may be inferred that the violence of the fall was very severe,

and that this healthy spleen only yielded to overpowering violence.

The other instance of rupture of a *healthy* spleen, The other case of rupture of healthy spleen, is, *Case No. 6, Myadhur Kolutani*, woman, ætat 20. She was struck, on the left side, by a heavy blow with a massive wooden-mallet ; the stomach was distended with rice, at the time ; the healthy spleen was split, by severe localised blow of a massive body. in three places ; each rupture being from 2 inches, to 3 inches, long, and $\frac{1}{4}$, to $\frac{1}{2}$, inch, deep. There were no injuries to other viscera. Death was immediate.

In this case, the violence was of an exceptionally overwhelming nature, and was in the form of a localised blow directly over the region of the spleen. Spleen crushed against distended, hard, stomach. This viscus was taken between the crushing blow, on the outside, and the hard, unyielding, rice-distended, stomach, on the inside ; consequently, though healthy, it was shattered—as an orange would be, if placed on an anvil, and struck, on the other side, with a heavy hammer. Not even the most healthy and firm spleen is capable of withstanding, uninjured, such violence as that in the above case.

The third case of injury to a *healthy* spleen, was of the nature of a *bruise*—by a *fall*. Third case of healthy spleen.

Case No. 38, Shombaroo Sheikh, ætat 18, fell from a height—8 feet, 3 inches—to the ground, on to the left side ; the abdomen, about level of umbilicus, on left side, impinged on a blunt bamboo stump ; in this region, there was a skin wound, and severe ecchymosis. He survived, for seven hours. On dissection, Bruise of spleen. Double rupture of stomach.

Spleen
bruised.

the *stomach* was found still distended with rice ; it was ruptured, in two places, at cardiac end, where it lay in contact with spleen. No signs of ulceration, or disease, of the coats of stomach, could be found.

Stomach
had two
ruptures.

The spleen was firm and healthy, and lay entirely behind the lower ribs ; there was a pink ecchymosis 3 inches \times 2 inches, and $\frac{1}{3}$ inch deep, on its concave surface, where it lay against the full stomach. No other injury on any portion of it.

Firm con-
dition of
spleen—
cause of
escape
from
rupture.

In this case, the firm condition of the healthy spleen enabled it to escape all injury from direct shock, or from contre-coup ; the bruise, on the concave surface, can only have resulted from the crush against the hard stomach. Had the stomach been empty and elastic, both it, and the spleen, would, probably, have escaped all injury.

Healthy
spleen not
liable to
injury.

Thus, the firm, healthy, spleen meeting the equally healthy, but distended, stomach, in collision, both suffered, at the face of contact, but the spleen had the lesser injury of the two ; showing that, when in health, the spleen is, by no means, a specially weak organ—so far as power of resistance to injury is concerned.

Illustrative
case. Rup-
ture of
gut—No
injury to
moderately
large
spleen.
By fall.

In Appendix A, are given details of a case—Sheikh Ram, ætat 20—in which even a moderately large and soft, malarial, spleen escaped all injury, though, from the shock of a heavy fall on to the abdomen, the small intestine (ileum) had sustained a severe rupture. The man, while carrying a heavy plantain tree on

his shoulder, tripped, and fell forward, in a prone condition, on to his face and abdomen, the heavy tree impinging across the prostrate man's back.

The moderately large and soft spleen showed no sign of any injury—there was no ecchymosis, nor any variation of its dark purple color, in any region.

The man died of peritonitis, from rupture of the intestine and escape of its contents.

General conclusion.

In the four instances in which *firm*, and either *healthy*, or *slightly enlarged*, spleens suffered *rupture*, (Cases Nos. 14, 1, 13, 6), we have evidence of the overpoweringly severe nature of the violence ; in the one case (No. 6), the direct evidence of the massive nature of the weapon, and of the localized impact of the blow ; in the other three, the indirect evidence furnished by the presence, in every case, of severe injury to other viscera.

In these 4 cases of rupture of firm spleen violence very severe. Evidence of this fact.

In estimating the value of this indirect evidence, the writer would adduce the following facts :—

In twenty-nine cases, in which the spleen, (of known consistency) was *ruptured* by falls, or blows, (omitting cases of *bruise*), in these last four, only, the spleen was more or less *firm and healthy* (*viz.*, in two *healthy* ; in two, *firm*, but enlarged).

Value of this indirect evidence of severity of the violence afforded by injuries of other viscera.

In twenty-five, it was not healthy—but *softened*, and *large*.

Among these twenty-nine total cases, eight showed injury to other viscera.

In the four cases of *firm* spleen, three had injury to other viscera.

In the twenty-five other cases, of *diseased* spleen, there were only five cases of injury to other viscera.

Thus, in the first set of cases, (of firm spleen), three-fourths showed such injuries to other viscera; in the second set (soft spleens), only one-fifth of the cases showed these injuries.

Conclusion
from this
evidence:
violence
shown
to be
severe.

Thus, if the presence, or absence, of injuries of other viscera, be taken as any measure of the degree of the injuring violence, such violence may be assumed to have been exceptionally severe in the three cases under discussion, in which, firm spleens gave way, only under violence of a more severe nature than that which sufficed to rupture twenty out of the twenty-five softened and enlarged spleens referred to.

CHAPTER VII.

Head V.—Period of Survival, and possibility of Recovery, in Injuries of the Spleen.

NOTES ON THE OPERATION OF REMOVAL OF THE SPLEEN.

(A.) *Period of survival* in injuries of spleen.—In *Head V*,
28 cases—
twenty-eight, of these thirty-nine cases in which 2 lived,
injury to the spleen was a cause of death, there is a 26 died.
definite record of the period of survival. Of these
twenty-eight cases, two recovered, twenty-six died.

The two which recovered were both cases of *The two*
bruise, merely ; one has been verified by *post mortem* *which lived*
examination ; the other has not yet been so, as the *were bruise*
man is still living. *cases.*

These two cases were as follows :—

Case No. 37, Simbi Garo, ætat 40, dissected on 21st *Case of*
August, 1879.—The man had been pounded, by the *recovery*
feet, knees, &c., of several assailants ; he suffered from *from bruise*
severe pain over the region of spleen, and from deep *of spleen,*
pain, in this region, on motion ; there was fever, and
the man was ill for twenty days ; he recovered,
eventually. He died of diarrhœa, a long time after- *verified by*
wards, and, on dissection, there were found, on the *dissection*
convex surface of the spleen, two white, puckered, *after a long*
time.

patches of effused, organised, fibrin, involving the capsule, and extending, about one-fifth inch, into the substance of the spleen; of irregular outline, sharply marked off from the rest of the capsule, which was shiny and translucent.

These were evidently marks of old effusions—from bruise, which had been recovered from.

Second case
of recovery
from
bruise of
spleen,

Case No. 34, Mohiram, ætat 39, was injured, by pounding with feet, knees, &c., of several assailants. Was admitted to hospital, on 29th March, 1879; he remained under treatment for eighteen days; eventually recovered, and is still living. The symptoms were carefully watched, for eighteen days; and, from comparison of this case with similar ones which have ended fatally and been verified by dissection, the writer feels sure that this case was one of bruise of the convex surface of the spleen. The diagnosis has not, however, been verified by dissection.*

not verified
by dis-
section.

Difficulty
of proving
recovery,
as evidence
is necessa-
rily, to a
large ex-
tent, nega-
tive or
delayed.

Herein, lies much of the difficulty of demonstrating recovery from these injuries of the spleen; for, if a case recover, the diagnosis cannot be verified, at the time, by dissection, and, therefore, is never quite beyond doubt; and, even when opportunity for dissection does occur, at some after-period, and marks of injuries are found, altered by time and reparative changes, still, as time has elapsed since the injury, the dependence, of the marks, on the previous injury, as cause and effect, is, to some extent, open to question.

* For full details of these cases, see Chapter X.

It will be seen, from Table VI over-leaf, that, of ^{In 26} twenty-six cases, three only were fatal immediately, ^{cases,} ^{5 were} and two others, almost immediately; while fifteen ^{quickly} ^{fatal.} survived the injury, for periods varying from two hours to five days.

Further details of the cases are given, to show to what is due the great differences noted in the periods of survival.

Two cases deserve especial notice here, as, in ^{Two cases} both, it is highly probable that recovery might have ^{for notice.} taken place from the injury to the spleen, but that ^{Death from} death was caused by the injuries to other viscera, ^{injury of} ^{other} ^{viscera.} complicating the case :—

I. Case No. 14, Woochem Garo (detailed later ^{Case No.} on)—Spleen injury in process of recovery. ^{14: Spleen} The wound in ^{wound in} the spleen was in fair process of reco- ^{process of} very, it was blocked by a firm, semi-organised, clot; ^{recovery.} the period of danger from hæmorrhage, shock, and peritonitis, had passed, when, five days after the injury, congestion of the lungs, and endocarditis, caused death.

II. Case No. 38, Shombaroo—From a fall, from a ^{Case No.} platform 8 feet 3 inches high—a healthy spleen ^{38: Bruise} received a bruise, on the concave surface, while, ^{of healthy} at the same time, the distended stomach suffered ^{spleen.} double rupture. ^{Death from} Death occurred in seven hours; ^{rupture of} ^{stomach.} apparently, mainly as the result of the ruptures of the stomach, and escape of some of its contents into peritoneum.

The experiences of other cases teach us that it is

not in the nature of bruises of the spleen to cause such rapid death. This bruise might have been recovered from—judging from similar cases—but that the stomach injury, of itself, chiefly, produced the fatal event.

The following, Table VI, is an analysis of the twenty-six cases which died, as regards the periods of known survival:—

TABLE VI.

Period of survival of twenty-six cases of injury to spleen.

| | | | | | |
|------------------------|-----|-----------------|---|------------|--|
| 26 cases | { | Caused by falls | ... | ... | 15 |
| | | Do. by blows | ... | ... | 10 |
| | | Do. by gunshot | ... | ... | 1 |
| <hr/> | | | | | |
| A.—Caused by blows... | 10 | { | Ruptures | ... | 9 |
| | | | Bruise | ... | 1 |
| <hr/> | | | | | |
| Immediately fatal | ... | 2 (Nos. 4, 6) | { No injury to other viscera, in either. | | |
| Survived a few minutes | ... | 1 (No. 24) | No other injuries. | | |
| Ditto half an hour | ... | 1 (No. 1) | Rupture of colon also. | | |
| Ditto two hours | ... | 2 (Nos. 15, 31) | { No. 15. No injury to other viscera. No. 31. Lung, right, congested, effusion into each pleura. | | |
| Ditto five hours | ... | 1 (No. 2) | No other injury. | | |
| Ditto six hours | ... | 1 (No. 36) | No other injury. | | |
| Ditto four days | ... | 2 | { | 1 (No. 35) | { Rupture of spleen-substance, capsule intact (Class II) |
| | | | | 1 (No. 33) | { Bruise of spleen-convex; bruise and congestion of left lung. |

B.—Caused by falls ... 15 { 14 Ruptures.
1 Bruise.

Immediately fatal ... 1 (No. 7) No other injuries.

Almost immediately so ... 2 { 1 (No. 5) No other injury.
1 (No. 8) No other injury.

Survived a few minutes ... 2 { 1 (No. 18) } No other in-
1 (No. 20) } jury.

Ditto half an hour ... 2 { 1 (No. 17) { Lungs, both con-
1 (No. 39) } gested superficially.
No other injury.

Ditto three hours ... 2 { 1 (No. 10) { *Lung*, left, ruptured.
Do., both, congested.
1 (No. 21) { *Ribs*, left, from 2nd
to 6th, broken.
Pleura, left, pierced
by 3rd rib.

Ditto four hours ... 1 (No. 19) No other injury.

Ditto six hours ... 2 { 1 (No. 23) No other injury.
1 (No. 13) Lungs both
bruised, and scarlet, on
surface.

Ditto seven hours ... 1 (No. 38) { Spleen bruised.
Stomach had two
ruptures.

Ditto two-half days ... 1 (No. 3) No other injury.

Ditto five days ... 1 (No. 14) { Lungs both intense-
ly congested.
Endocarditis.

C.—Caused by gunshot 1.

Survived four hours ... 1 (No. 11) { Bullet transfixed
abdomen; pierced
stomach, jejunum,
and colon.

Of the five cases in which death supervened imme- Cases of
diately, or almost so, three were caused by falls, two, rapid
by blows :— death.

a.—Case No. 5, *Adhur Rabha*—injured by a Case No. 5
Rupture of

lower end : fall.—An enlarged, soft, spleen had a rent along rapid death. lower margin; the head was injured, and right wrist dislocated.

Case No. 4: *b.—Case No. 4, Dome Kos*—injured by blows with the hand.—A greatly enlarged spleen had a single, long, rupture, along the anterior margin; the abdominal cavity was full of liquid blood; the other viscera of body being ex-sanguine.

Case No. 6: *c.—Case No. 6, Myadhur Kolitani*—injury was caused by a crushing blow with a massive wooden-mallet.—The stomach was distended with rice, and, though the spleen was healthy, it was crushed against the hard stomach, and ruptured in three places, *viz.* :—one rupture, 3 inches long, and $\frac{1}{2}$ inch deep, on convex; and two, on concave, each 2 inches, to 3 inches, long, and from $\frac{1}{4}$ inch, to $\frac{1}{2}$ inch, deep; the peritoneum was filled with fluid blood, and all other viscera were ex-sanguine.

Case No. 8: *d.—Case No. 8, Jumru Ram*—injured by a fall from tree.—The convex surface, and posterior edge, of spleen, were shattered; stomach was almost empty; the abdominal cavity filled with blood, the rest of the body being ex-sanguine.

Case No. 7: *e.—Case No. 7, Kandoorah Garo*—injured by a fall.—A very enlarged spleen had a single rupture, on concave surface, 3 inches long, $\frac{1}{2}$ inch deep. There was great effusion of blood into the abdominal cavity.

In above cases, death from copious, and rapid, hæmorrhage into abdominal

cavity. In two of them, the rupture was single. All rapid bleeding. five cases were without any other injury, beyond that to the spleen.

In Cases No. 4, and 5—the rupture was single, and not extensive, but was on peripheral portion of the spleen, viz., lower end, and anterior border. In two, the rupture single, but on periphery.

Three cases lived for a few minutes. In none of them was there injury of any other viscera :—

Case No. 24, Doosaram.—While ploughing, was struck, with great violence, with the yoke of a native plough, the frightened oxen having stampeded. A very large and soft spleen was split into halves, transversely, from both surfaces, at junction of upper and middle third; the two portions were only connected, by a few trabeculæ, towards the centre. The man lived, for a few minutes; much blood was effused into abdominal cavity, a portion of which had time to form clots among the intestines. The spleen, when washed, weighed 44 ounces. Case No. 24 : Soft spleen split in half. Some clots among the intestines. Spleen weighed 44 oz.

Case No. 18, Kankata Surma.—From a fall, there was rupture of a large and very soft spleen, in two places, viz., one, across upper margin of convex ; and a cross-shaped rupture, from margin to margin of concave, through hilus ; there was effusion of blood into the sheaths of the great vessels, and into the areolar tissue of hilus. Spleen weighed 28 ounces. The abdomen was full of blood. Case No. 18 : Spleen fissured on both surfaces. Weighed 28 oz.

Case No. 20, Bagsaul.—From a fall, a very large and soft spleen suffered double rupture—one fissure Case No. 20: Double rupture of

very large, being at lower portion of posterior edge, the other, and soft, across concave, from hilus to posterior edge. The spleen. cavity of abdomen was full of blood.

Three cases lived, for half an hour. Two of them were complicated by injuries to other viscera :—

Case No. 17: *Case No. 17, Dhorma Kolita.*—From fall from a tree. The stomach was distended with rice, and the spleen crushed against full stomach; large, soft, spleen—crushed against it—suffered five ruptures, viz., three, transversely, across convex—
5 ruptures; one being right across, and half through, spleen, at its both lungs injured. lower part; and two, transverse ones, across lower portion of concave surface. The abdomen was full of blood.* Both lungs were, superficially, congested.

Case No. 1: *Case No. 1, Kanda Thakor*—injured by blows with the hand.—A slightly enlarged, firm, spleen had a single rupture, $2\frac{1}{2}$ inch long, $\frac{3}{4}$ inch deep, across concave surface. The stomach was full. The colon was ruptured at the angle of junction of transverse and descending portion. Nearly all the blood of the body was found in the abdominal cavity. Yet, this man lived for half an hour.

Case No. 39: *Case No. 39, Khedala, ætat 54*—injured by a fall to the ground, while stepping over a ditch.—The double rupture of soft spleen. Copious hæmorrhage. large, soft, spleen had two transverse ruptures across the concave surface; one of these being starred, in

* This case is worthy of note, as these five severe ruptures of the spleen, together with the injury to the lungs, had survived for half an hour; an event that would seem highly unlikely to happen, considering the injuries.

the region behind the hilus. The stomach was full of rice. Abdominal cavity was filled with dark, fluid, blood.

Two cases survived, for about two hours :—

Case No. 15, Polton, ætat 45—was pounded with the knees, feet, &c., of assailants, and beaten with shoes.—A moderately soft and enlarged spleen had a star-shaped rupture, $1\frac{1}{2}$ inch across, and $\frac{1}{3}$ inch deep, on concave surface. Stomach was empty. Much blood, partially clotted, was in abdominal cavity. No other injuries. The wound of spleen was blocked up by a soft clot.

Case No 15:
From
pounding,
starred
rupture,
wound
blocked up
by soft clot.

Case No. 31, Goomaroo—injured by blows with a bamboo stick.—The spleen was very soft and large, like a mere bag of blood; it was ruptured, and the abdominal cavity was full of fluid blood. The right lung was congested; and each pleura contained about 8 ounces of bloody serum. Yet, this man lived, for two hours, after the injury—which, from the nature of the hurt, would have seemed highly improbable.

Case No. 31:
Spleen very
soft and
large,
ruptured;
lung and
pleura
injured.

Two cases survived, for three hours :—

In both, the spleen suffered multiple rupture, and there were injuries of other viscera.

Case No. 21, Dobago, ætat 45—injured by fall from a tree.—The spleen was large and soft; it sustained three ruptures—two on concave, one on convex, viz.:—one, on concave, midway between hilus and upper margin—this was a transverse fissure, from

Case No. 21:
Spleen had
3 large
ruptures.

posterior edge, across inner surface, round anterior margin, and, for $\frac{3}{4}$ inch, on to convex surface, gaping nearly 2 inches wide ; the second one, on concave, was opposite hilus—a superficial fissure, $1\frac{1}{2}$ inch long ; the third rupture was on convex, transversely, above middle of the spleen from posterior, nearly to anterior, edge, about $\frac{1}{2}$ inch deep.

Injuries to spleen and pleura, fractures of wrist and ribs.

There were, also, the following injuries :—Colles's fracture of the right wrist ; the left ribs, from 2nd to 6th, inclusive, fractured near their angles ; the left pleura, pierced by the broken end of 3rd rib. These extensive injuries were survived, for three hours.

Case No. 10 : Injuries, extensive, to spleen and lung.

Case No. 10, Bhokaroo Konch—injured by a fall.—A large and soft spleen was split, transversely, across concave surface, almost into two equal halves, through hilus.

Stomach distended.

The stomach was distended with a mass of rice, and, evidently, had come into violent collision with the spleen. All the tissues and organs of the body were bloodless, while the abdominal cavity was filled with fluid blood. The fissure, across spleen, was blocked

Lung ruptured.

up by a large, soft, clot. The left lung had a rupture, $\frac{1}{2}$ inch long, on anterior surface, blocked up by a clot ; this lung was severely congested.

Comment.

Considering the extent of these injuries, it is surprising that each of these cases should have survived for three hours.

Two cases survived, for four hours :—

Case No. 11 : Gun-shot wound of

Case No. 11, Motia Cachari—was shott through the body, from side to side, with a bullet, or slug, out of a

smooth-bore.—The ball entered below 11th left rib, spleen, colon, stomach, and small intestine. pierced descending colon, and some coils of small intestine (jejunum); passed through spleen, and cardiac end of the stomach; and, finally, made its exit, by smashing the cartilage of the right 9th rib. Much blood was effused into abdominal cavity. With these terrible injuries, the man survived, for four hours.

Case No. 19, Shookna—injured by a fall from a tree.—Case No. 19: Very large and soft spleen. 4 ruptures. A very large and soft spleen sustained four ruptures—three on the convex, *viz.*:—one, right across, from anterior, to posterior, border, at about the middle of the viscus; and two others, near the upper portion; the fourth rupture was on the concave, near upper portion. With all these injuries, there was not much effusion of blood into the abdomen, though the man (perhaps, in consequence), lived, for four hours, after the injury. Survived for 4 hours. Not much blood effused.

One case survived, for five hours.

The rupture was single—there was no injury to other viscera:—

Case No. 2, Kalamoni, ætat 50—was beaten with a bamboo stick.—An enlarged, soft, spleen had a rupture, on concave surface, from hilus to upper end. There was no injury of other viscera. Much blood was effused into abdominal cavity, and, there, partially coagulated. Case No. 2: Single rupture. Much effusion. Survived 5 hours.

Three cases survived, for six hours.

In all three, the rupture of spleen was single; two, had no other injuries:—

Case No. 13, Heho Kolita, ætat 13—injured by Case No. 13: Spleen ruptured.

fall from a tree.—A healthy spleen had a single rupture, 4 inches long, $\frac{1}{3}$ inch deep, across convex.

Much blood was effused into abdominal cavity.

Both lungs
bruised.

Survived
for 6 hours.

Both lungs were severely bruised, and of a bright scarlet color on their anterior surfaces.

Case No.
23: Spleen
had single
rupture, in
a jaundiced
person;
lived for
6 hours,—
no clots
formed.

Case No. 23, Ram Hera—fell from a tree, 18 feet high, on to the left side. He had, recently, suffered from fever, and jaundice. The spleen was very large and soft, weighed 30 ounces. There was a rupture right across concave surface, one inch from upper end, $\frac{1}{2}$ inch deep, gaping $\frac{1}{2}$ inch wide. There were no other injuries.

Much effu-
sion of
blood—
liquid.

After the accident, he called for assistance, and, with it, walked, about 200 yards, to his house; was sensible, and conversed, for the next hour; then became insensible, and remained so for the next five hours, when he died. This man had, recently, suffered from fever, and was jaundiced at the time of injury. Though he survived for six hours, and copious hæmorrhage had taken place from the spleen wound, yet there was no attempt at formation of a clot, either in the spleen wound, or in the blood effused among the intestines.

The per-
manent
fluidity of
the effused
blood due
to the
jaundiced
condition.

The long period of survival, in this case, was, probably, owing to the insensible condition in which the person remained for the last five, of the six, hours, during which he survived the injury. This insensibility probably reduced the force of the circulation, and, thus, in some measure, controlled the bleeding.

We know that the presence of bile, in the blood, impairs, or destroys, its coagulating power. The permanent fluidity of the effused blood, and the entire absence of any clotting, were, presumably, due to the jaundiced condition of the injured man.

Case No. 36.—The man, after a beating with a bamboo stick, walked, and carried his load of dhan, for some distance ; he became, gradually, sick, and faint, but was conscious for five hours after the injury. There was a rupture, on convex surface, of a large, soft, spleen.

Case No. 36 : Survived 6 hours ; carried load after the injury.

One case survived, for seven hours :—

Case No. 38, Shombaroo—has been already alluded to, above, as a case in which the injury to the spleen might have been recovered from.

Case No. 38.

Four cases survived, for several days.

One, for two and-a-half days :—

Case No. 3, Rungoo Nath—injured by fall from a tree.—The enlarged, soft, spleen had a single rupture.

Case No. 3.

Two cases survived, for four days :—

Case No. 33, Narah Koiburto—was severely pounded by the knees, feet, &c., of several assailants. He was admitted to hospital suffering from great pain over the spleen—rendered acute by deep pressure, or by motion—some exhaustion, and diarrhœa. Increasing congestion of the left lung proved fatal.

Case No. 33 : Bruise of spleen, bruise and congestion of left lung—survived for 4 days.

There was found, a patch of dark purple ecchymosis, on the convex surface, 2 inches \times 1½ inches, and ½ inch to ½ inch, deep.

The left lung was pink, from ecchymosis, on its anterior surface, and this lung, generally, was much congested. Stomach empty, at time of injury.

Case
No. 35 :
Rupture of
spleen tis-
sue; capsule
intact.

Case No. 35, Chunkea Soobha.—This case has been fully detailed, in Chapter III, Class II.

He was exercising, at the gymnasium, after a heavy meal of rice : owing to a slip of the hands, the spleen was brought into severe collision with one of the parallel bars, and was shattered, between the bar, on outside, and the dense, distended, stomach, on inside.

Lived for
4 days.

Sudden
death while
rising in
bed.

He walked about 150 yards, to hospital, after the injury. With no very marked symptoms (beyond pain over spleen, and permanent rise of two degrees in temperature), he lived for four days. Suddenly, while raising himself in bed, he died.

*Post
mortem
appear-
ances.*

Post mortem appearances.—The spleen capsule was found enormously thick, like chamois leather. It had remained intact, at the time of the injury, while, inside it, the soft tissue of an enlarged spleen had been shattered in pieces. Bleeding had gone on, inside the intact capsule, distending it into a globular form, and, eventually, firmly clotting inside it, taking the form of the capsule and of the fissures between the ruptured portions of the spleen tissue. During the four days of survival, the capsule gradually softened, in parts where the spleen tissue was separated from contact with it. Eventually, the action of the abdominal muscles (when the man raised himself)

compressed, apparently, the spleen, against the spine, and caused the capsule, and its contained clot, to rupture, in many places. Death was, then, instantaneous.

This period of survival—four days—seems entirely due to the capsule having remained intact ; when once distended to its limit, this intact capsule put a period to further bleeding, and prevented any blood from being effused into the abdominal cavity. Had the capsule given way at the time of injury, as the spleen tissue did, the very extensive ruptures of this tissue must have caused copious, and rapid, hæmorrhage into abdominal cavity, and quick death. There was, however, no such hæmorrhage.

One case survived, for five days :—

Case No. 14, Woochem—injured by fall from a tree.—An enlarged, but firm, spleen sustained a single rupture, 1 inch long, $\frac{1}{3}$ inch deep, across convex. The man lived for five days. On dissection, the wound of spleen was found blocked up by a firm, partially-organised, clot ; only a few drops of blood had escaped, these were found, coagulated, among the intestines, and caused no symptoms of peritonitis. Both lungs were intensely congested ; the endocardium was of a pink color, from minute injection of its bloodvessels, especially over the valves, and for a short way up the aorta.

Period of survival, 4 days, due to intact capsule.

Case No. 14 ; Healthy spleen, slight rupture, recovering, when heart and lung injury caused death.

In this case, the period of danger, from the spleen rupture,—whether from shock, hæmorrhage, or perito-

nititis—had passed. The real cause of death seemed to be the congestion of the lungs, and the endocarditis. The wound of spleen had undergone a reparative process, and was fairly on the way to recovery.

Causes of varying period of survival.

Causes of
varying
periods of
survival.

It will be observed that, in the above detailed cases, rupture of the spleen was, rarely, quickly fatal—in less than one-fifth of the cases, indeed.

What are the conditions which contribute to a rapidly fatal ending?

Copious
rapid
hæmorrhage.

Rapid and copious hæmorrhage into the peritoneum occurred in all the quickly fatal cases.

Region of
spleen
wound.

It is by no means easy to explain, why, in two cases of single, non-extensive, rupture of the spleen, immediate death (or nearly immediate) ensued; whilst another case (No. 10), in which the spleen was split almost into two parts, survived for three hours, and had its wound blocked up by a clot.

It would seem, that wounds at, or near, the hilus are less rapidly fatal than those of the more peripheral parts—the convex surface, or margins. Probably, when the vessels entering at the hilus are injured, after a primary gush the ruptured arteries are capable of contracting, and closing, as they might do elsewhere, and, in this way, the hæmorrhage may be controlled, by a natural process.

Main
afferent
vessels
injured,

When the wounds are on the more peripheral parts of the spleen, away from the hilus, these afferent

vessels, of the hilus, remain intact, and continue the blood-supply; while the abundant venous plexuses of the spleen-substance, and the altered vessels in that diseased viscus, opened by the rupture, give rise to copious bleeding, which continues, without much chance of control, and without much tendency to closure of the vessels by coagulation. Of the more or less immediately fatal cases arising from single ruptures (non-extensive), one (No. 4) was on anterior margin; one (No. 5) on the lower end; two other cases, immediately fatal, had multiple, and extensive, injuries.

Of two cases (Nos. 24, and 10) in which large, soft spleens were split into two parts, it will be noticed that, in one (No. 24), the rupture was on a portion of spleen away from the hilus, *viz.*, at junction of upper, and middle, thirds, and that death occurred, in a few minutes; while, in the other (No. 10), where the rupture was through the hilus, the man survived for three hours, and the gaping wound of the spleen was blocked up by a clot, indicating an exercise of some power of repair.

In this case, the injured person remained in a state of insensibility during most of the period of survival—this, probably, controlled the bleeding, and prolonged survival.

In the three cases, noted as having survived only a few minutes, in each instance the spleen had ruptures at, or near, the margins.

closure
ensues and
supply of
blood
ceases; and
conversely.

Two cases
of margin
injury
immediate-
ly fatal.

Cases of
severe
injury
through
hilus
with long
survival.

Cases,
margin
injury.

Injuries at
hilus.

In Case No. 15, which survived for two hours, the rupture was star-shaped, extending into the hilus; the wound became blocked up by a soft clot.

In Case No. 2, which survived for five hours, the hilus was included in the injury.

Conclusion.

Thus, we have several cases of single injury, in which death rapidly supervened, when the peripheral portions of the spleen (those most removed from the hilus) were the seat of the rupture; and other instances of prolonged survival, and attempts at repair, in even multiple and extensive ruptures, when the hilus, or regions near it, were involved.

Insensibility probably increases the chances of prolonged survival.

Insensibili-
ty—
survival
prolonged
by.
Case
No. 10.

It is probable that, in Case No. 10, above detailed, the state of insensibility of the injured person tended to reduce the circulation to a minimum, and thus, by rendering the hæmorrhage from the spleen wound less rapid, to prolong the period of survival, and to promote the formation of a clot in the wound.

Case No. 23.

In Case No. 23, Ram Hera, the patient survived, for six hours, a gaping wound of the upper portion of the concave surface; but five, of the six, hours of survival, were passed in a state of insensibility.

In both the above cases (Nos. 10, & 23) insensibility seems to have prolonged the period of survival.

After
jaundice no
coagula-
tion of
blood.

Influence of bile in the blood.—In Case No. 23, it is interesting to note, too, that the injured person had recently suffered from jaundice, and that no

clot formed, in the spleen wound, during the six hours of survival ; though, in Cases Nos. 15, and 10, such clots had formed in two, and in three, hours, respectively.

We know that the presence of bile, in the blood, diminishes its coagulating power.

Influence of the condition of the Spleen.—In Case No. 14, which survived for five days, the rupture was on the convex surface, but was very slight, viz., 1 inch long, $\frac{1}{3}$ inch deep ; the spleen was healthy, and firm. The wound of the spleen must have become rapidly blocked by a clot, as only a few drops of blood were found—coagulated—in the abdominal cavity, after death. At the time of dissection, the clot, in the spleen wound, was firm, and partially organised.

Condition of spleen ; influence on survival.

Case, firm, healthy, spleen ; rupture repaired.

An enlarged, soft, spleen, distended with blood, will be liable to sustain more extensive rupture, than a small firm one ; and the gush of blood, from it, will be much more copious and sudden. In cases of rupture of spleens which have the appearance, and consistency, of “ mere bags of blood,” we may expect copious hæmorrhage, and rapid death.

In soft, large, spleen, hæmorrhage copious, death rapid.

Influence of malarial cachexia.—The generally depraved condition of health, known as malarial cachexia, is characterized by deficiency in the number of red corpuscles, and diminished coagulability of the blood ; and, hence, it may be assumed that the anæmic blood, distending a malarially enlarged

Influence of malarial cachexia on period of survival.

spleen, will not have much tendency to coagulate and block up the wound.

Of 32 cases
in 3 only
were clots
found in
spleen
wound.

Out of thirty-two cases of rupture of the spleen (omitting wounds by gunshot, or by tiger, and the four cases of bruise), in three, only, were there clots found closing the wound of that viscus (Nos. 10, 14, 15).

In two, of these three cases, the spleen was not far departed from a healthy condition.

Injury of
other
viscera,
influencing
survival.

Presence or absence of injury of other viscera as influencing period of survival.—Of 39 cases of injury to the spleen, in 13 were there injuries to other viscera.

In three of these cases, the period of survival was not certainly known. In ten cases, period of survival was recorded.

Stomach, 2
Colon, 1
Lungs }
Pleura } 7

In none of these ten cases, did death take place immediately. The injured viscera were ;—stomach, in two cases—by gunshot, in one; colon, in one; lungs and pleura in seven—with heart, in one case.

Case No. 38. In Case No. 38, spleen was healthy, and was only bruised; stomach was ruptured, in two places. Survived for seven hours.

In three other cases of bruise of spleen, two recovered, one died in five days. So that the rapid death, in Case No. 38, seems chiefly to have been due to the injury to the stomach.

Case No. 1.
—Rupture
of firm

In Case No. 1, by a blow with the hand, a firm spleen was ruptured, on convex surface; the wound

was $2\frac{1}{2}$ inches long, $\frac{3}{4}$ inch deep ; colon was ruptured, spleen and of colon.
also. Survived, for half an hour.

All the blood of the body was found, fluid, in the abdominal cavity. Death, evidently, occurred from this Injury of colon not influencing period of survival.
copious bleeding ; and the injury of colon, probably, had little effect in determining the period of survival.

In nine cases of rupture of the spleen, in which the Cases, lung and pleura injured.
lung, or pleura, also, suffered injury, the periods of survival, in seven, were known to have been :— $\frac{1}{2}$, 2, 3, 3, 6, hours, 4 days, and 5 days, respectively.

From comparison, of these periods, with those in Lung injury did not hasten death.
other cases in which there was no injury to lung, or to other viscera, it is seen that the addition of the lung injury did not, in the above cases, to any marked extent, hasten the advent of death.

In Case No. 10—by a fall, the enlarged spleen was Case No. 10 : Spleen and lung ruptured.
split, transversely, almost in two, from the concave surface. No rib was broken, but the left lung suffered rupture from shock, and was severely congested, especially, towards the anterior, and left, surfaces.

This man survived, for three hours. The lung Survived for 3 hours.
injury does not seem to have hastened the fatal event—indeed it is astonishing to find such an injury of the spleen survived for so long a period.

In Case No. 31—by blows with a bamboo stick, a Case No. 31 : Ruptured spleen, injury to lung and pleura.
very large, soft, spleen was ruptured. The right lung was congested, and, into each pleura, were effused 8 ounces of bloody serum. Survived, for two hours.

Influence of
lung injury
on survival.

Injuries of the lungs seem not so much to assist in causing rapid death, as to induce progressive congestion, and inflammation, during the next few days, and so, eventually, to ensure a fatal ending, should the patient tend to survive the spleen injury.

Case No.
14 : Rup-
ture of
spleen re-
covering ;

In Case No. 14—a firm spleen suffered a slight rupture, on the convex surface—the man lived, for five days. Both lungs were found severely congested, and the endocardium was pink—from injection of its vessels.

Lung and
heart mis-
chief caus-
ed the fatal
ending.

The wound of the spleen was in process of healing, it was blocked by a firm, semi-organised, clot ; only a few drops of blood had escaped into the abdominal cavity, these had coagulated, and caused no peritoneal irritation. The period of danger from the spleen wound itself (*viz.*, danger from shock, bleeding, peritonitis) had well passed ; complete recovery might, probably, have ensued, but that the progressive mischief to the lungs put a period to the experiment.

Case No.
33 : Firm
spleen
bruised,
congestion
of lung
caused
death.

In Case No. 33—from pounding with feet, &c., the spleen, though firm, was bruised ; the left lung was found severely congested, and pink over its surface, from ecchymosis. Survived, for five days. The progressive lung mischief appears to have caused the fatal ending.

Case
No. 11 :
Gunshot
wound of
spleen,
stomach
colon and

Case No. 11—Motia Cachari (detailed above)—is interesting, as showing how long a period may be survived over, even in the most extensive injuries to the viscera of abdomen.

This man was shot through the abdomen, from side to side, with a ball (or slug) from a smooth-bore gun. The large intestine, some coils of small intestine, the spleen, and the stomach, were pierced. Yet this man survived these terrible injuries, for four hours.

small in-
testines ;
survived
for 4
hours.

The general conclusion seems to be, that whatever condition tends to moderate, or control, the hæmorrhage, from the ruptured spleen, tends to prolong the period of survival.

We may sum up the conditions influencing the period of survival, thus:—

1. The extent, and depth, of the rupture.
2. The region of spleen on which the injury is situated. Whether near hilus, or on peripheral parts.
3. A state of insensibility, or of quiescence, of the person, after the injury.
4. The condition of spleen as regards health, or disease, as influencing the rapidity of the bleeding, and the tendency to repair.
5. Conditions influencing the coagulating power of the blood, as—
 - a.—Jaundiced condition of the injured person.
 - b.—Malarial cachexia.
6. Presence, or absence, of injury of other viscera.

Six main
conditions
influenc-
ing period
of surviv-
al.

Possibility of recovery from injuries of the spleen.

A.—*Bruises*.—This subject has been fully discussed in Chapter II, Class I, Bruises of the Spleen.

Recovery
from
bruises.

It is, there, shown that two cases, of *bruise* of spleen, recovered ; one (No. 37) was verified, by dissection, on death ensuing, from other causes, a long time afterwards ; the other (No. 34) has not yet been verified by dissection, as the man still lives.

It is shown, too, that, in two cases of death having followed *bruise* of the spleen, the main symptoms, and the mode of death, in both, were due to the severe injuries of other viscera. These injuries of other viscera, in both cases, caused death, while the spleen injury seemed to go for little, or nothing, as a cause.

Rupture
blocked by
a clot, is a
step to-
wards
recovery.

B.—Possibility of recovery from ruptures of the spleen.
—In those cases of *rupture* of the spleen in which the wound of that viscus becomes so rapidly blocked up, by a clot, that but little blood is effused into the peritoneal cavity, nature, apparently, has made an effort at repair—a step towards cure.

With
diseased
spleen, and
malarial
blood,
little ten-
dency to
heal.

It has been noted, above, that a much enlarged spleen, from its diseased condition and altered structure, will, probably, not manifest any marked tendency to closure of the wound of its substance ; moreover, the degenerate blood of the malarial cachectic, undergoing changes in the malarially enlarged spleen, will have its coagulability deteriorated.

Rupture of
spleen in a
jaundiced
person,
no clot
formed
though
survived 6
hours.

Again, in Case 23—the coagulating power of the blood seems to have been diminished, by an attack of jaundice, from which the man had recently suffered. Bile, in the blood, is known to, more or less, destroy its coagulability. Though this man survived the rup-

ture of the spleen, for six hours (probably on account of his insensible state), yet, nature had not succeeded in plugging the wound with a clot; and bleeding seems to have, steadily, gone on—controlled, somewhat, by the insensible, quiescent, condition of the injured man. The man seems, practically, to have slowly bled to death, the effusion taking place into the cavity of the abdomen.

Whatever conditions control the bleeding from the ruptured spleen, or favour rapid coagulation, the period of survival prolong and increase the chances of recovery.

Insensibility, has been noted as, probably, tending to prolong survival, by nearly reducing the circulation to a stand-still; therefore, assisting the formation of a clot, as in Case No. 10, or, controlling the bleeding, as in Case No. 23. It would, therefore, tend to assist nature in any attempt at recovery.

Insensible
state assists
formation
of clot.

In Case No. 10, a rupture, nearly dividing the spleen in two, was filled up, by a large, soft, clot, within three hours, so as to quite stop further bleeding; this clot formed in the wound of a large and soft spleen, owing, probably, to the prolonged insensibility of the patient.

Case No.
10:—
Insensible
state; clot
formed.

When much effusion of blood takes place into the abdominal cavity, death, ordinarily, follows rapidly.

Rapid
effusion.

In Case No. 14 (above noted), in which the patient survived the rupture, for five days, only a few drops of blood had been effused into the abdominal cavity.

Slight
effusion of
blood.

Prolonged
survival.

In Case No. 19—Shokna—the patient survived the rupture, for four hours ; it was found that there was but little blood effused into the peritoneal cavity.

The less
effusion,
the less
chance of
peritonitis.

The smaller the amount of blood effused into peritoneal cavity, the greater should be the theoretical chances of recovery—so far as peritonitis is concerned.

Slight
effusion
becoming
absorbed or
organised.

It is quite in accordance with physiological laws, that a certain amount, only, of blood, effused into peritoneal cavity, might—like the fluid of ascites, or the discharges after ovariectomy—give rise to little

Two exam-
ples of this.

irritation, and, in process of time, become absorbed, or organised.

In the cases, herein, detailed, one man lived, for five days, another for two-and-a-half days, without any signs of peritonitis, from the blood effused into the abdominal cavity.

In survival
for several
days,

In cases which have survived for such periods as $2\frac{1}{2}$, 4, or 5, days, the spleen must have made a more or

spleen
made effort
at repair.
Cases.

less successful effort at repair of the injury. In Case No. 14—of rupture of the spleen surviving 5 days—the firm, healthy, condition of the spleen, probably, not only determined that the injury was slight, but also, indirectly, tended to prolong survival, and increase chances of recovery, by permitting the spleen to make the effort at repair which characterised this case.

The conditions, then, favouring the chance of recovery are :—

Summary
of condi-
tions

1. That the rupture should be single, and not extensive.

2. That the spleen should be not too far from healthy, in its structure. favouring chances of recovery.

3. The blood should be fairly healthy ; not depraved by any cachexia, or by any disease, such as jaundice, which impairs its coagulating power. The blood, in the splenic vein, returning from a *healthy* spleen, ordinarily contains an excess of fibrin, and is highly coagulable.

4. Insensibility, or quiescence, by reducing the circulation to a minimum, limits the effusion into the abdominal cavity, and favours the formation of a clot in the wound.

5. Absence of great effusion of blood into peritoneal cavity.

6. Absence of severe complicating injuries of other viscera.

In Case No. 14, Woochem, all these conditions seem to have been fulfilled, except the last. The spleen was firm, and only slightly enlarged ; the rupture was slight ; the wound was blocked, by a clot, so rapidly, that only a few drops of blood escaped into the cavity of the abdomen, where they coagulated. All these conditions, but one, in Case No. 14.

The man lived, for five days : dissection showed that the clot, in the spleen wound, was quite firm, and becoming organised ; that the clots, in the abdomen, were becoming organised, also ; that the period of danger from shock, hæmorrhage, or peritonitis had passed, in the five days of survival ; and, in fact, that the man was on the high road to recovery from the Spleen wound healing. Period of danger from it had passed

wound of the spleen, and its effects, when death occurred from intense congestion of both lungs, and endocarditis—caused by the original fall, and slowly progressing since.

Died of
heart and
lung
injury.

No signs of peritonitis were discoverable, either during life, or after death; the clots, in the abdomen, had attached themselves to the coils of the intestines.

Case
from N.
Chevers
of reco-
very from
slight
rupture of
convex.

A case, very like the above, is recorded in the *Indian Annals of Medical Science*, No. XV of 1862, p. 273, by Dr. French, in which “on the outer surface of the spleen, was a cicatrix of a former rupture, 1 inch in length, and, round it, there was an organised blood clot, of firm consistence, which adhered strongly to the organ and to the parietes of the abdomen.”

Similar to
the present
Case 14.

This is just the condition which Case No. 14 might have been found in, some months after, had the lung and heart complications not proved fatal, in his case, and, so, interfered with the further progress of the experiment.

Case No.
15, in 2
hours
spleen
wound
plugged
by a clot.

In Case No. 15—Polton—there was considerable effusion of blood into the abdominal cavity, and, though the man survived only two hours, the single rupture of the spleen was well blocked up by a soft clot.

No. 10, case
of exten-
sive
rupture
plugged by
clot.

Case No. 10, has, already, been alluded to. In this case, a large clot completely blocked up a very deep and extensive fissure of the spleen, and the man survived, for six hours.

The writer thinks, that such cases as No. 14—Slight rupture may be recovered from. Woochem—warrant the assumption that the spleen is capable of considerable reparative power ; and that, under favourable conditions (as noted above), slight cases of rupture of this viscus may be recovered from.

Had No. 14, Woochem, not suffered from these severe injuries, to the lungs and heart, which complicated his case, the facts seem to prove that he might have recovered from all the effects of the rupture of the spleen. Instance No. 14.

Another consideration, which leads him to believe in the possibility of recovery from slight ruptures of the spleen, is, that, on several occasions, in making Cicatrices of old injuries often found in dissecting. *post mortem* examinations of bodies, in this region—peculiarly fertile in cases of enlargement, and rupture, of the spleen—the writer has met with cicatrices, on the spleen, having, in every respect, the appearance of healed wounds of that viscus.

In one instance, there was white, puckered, depressed, linear, cicatrix, $1\frac{1}{4}$ inch long, across the middle of the convex surface. This fibrous cicatrix penetrated, about $\frac{1}{4}$ inch, into the spleen tissue. Two cases.

In a second instance, a similar, retracted, linear, cicatrix was on the concave surface, mid-way between hilus and upper end.

In this case, the capsule of the spleen was thickened, and fused into the cicatrix, in its region. There was also, a patch of thick, white, capsule, about 2 in. long, and $\frac{1}{2}$ in. wide, irregular in outline, across the middle Cicatrix of old injury.

of the convex surface. The rest of the capsule was shiny and translucent.

In both cases, the spleen, on dissection, was firm, and slightly enlarged.

In neither instance, could the writer get any history, as these men had no friends with them. They are, therefore, not included among these recorded cases.

Distin-
guish gum-
mata of
syphilis,

and embol-
lic nodules,

from scars

of old
injuries.

Difficulty
of proving
recovery—
from nega-
tive proofs.

The linear cicatrices, and thickened patches of capsule, in these two instances above referred to, in no way resembled the gummata (probably a tertiary syphilitic deposit) sometimes met with, in the spleen tissue (the writer has met with these, and is acquainted with their characters) ; nor were they, apparently, the result of embolisms, or apoplexies, of the splenic vessels, as, probably, are the cheesy nodules found, sometimes, in the spleen tissue. The writer cannot but think they were the cicatrices of old injuries.

It is difficult to conclusively prove that any specified case of rupture of the spleen has recovered ; if a case do recover, doubt always hangs over the diagnosis. The only certain proof, that rupture has existed, is the injury, itself, being found, on dissection.

This method cannot, ordinarily, be used to prove recovery from such injuries, for, if the patient recover, there can be no proof, by dissection, at the time ; and when dissection, after a long lapse of time, shows marks, apparently of injuries, the connection of these appearances with any old rupture—the interpretation

of the appearances, in fact—is, again, open to question.

To, finally, sum up the conclusions, arrived at, with regard to the period of survival, and possibility of recovery, in cases of injury to the spleen:—

Summary regarding survival and recovery in injuries of spleen.

The period of survival, and possibility of recovery, seem to depend, chiefly, on the degree of hæmorrhage into the abdominal cavity.

a.—When there is no such hæmorrhage, if the injury be a bruise, there is little doubt that recovery may take, and has taken, place (Cases Nos. 34, and 37); and even if death followed such a bruise, this has seemed chiefly due to severe injuries of other viscera—lungs, heart, stomach (Cases Nos. 33, and 38).

When no bleeding, if a bruise, may recover;

b.—When there is no such hæmorrhage, and the injury be a rupture of spleen tissue—bleeding being prevented by an intact capsule—survival may be prolonged far beyond the period which experience shows ever follows a rupture, of similar severity, when the capsule also, is torn, and affords no bar to hæmorrhage. (Case No. 35, survived, for four days, extensive shattering of spleen tissue—capsule not being ruptured at the time of injury.)

if rupture of spleen tissue, capsule intact, long period of survival.

c.—When the hæmorrhage is small in amount, and takes place slowly, the period of survival is much prolonged, and, it would seem that, recovery is possible.

When bleeding slight and slow, recovery possible,

Case No. 14, survived such rupture, for five days. The period of danger (shock, hæmorrhage, peri-

and survival prolonged.

tonitis), from the spleen injury, had passed, and the wound was blocked up by a firm, semi-organised, clot, when death occurred, from endocarditis, and congestion of the lungs, which had been progressing since the time of the injury.

And in case quoted from Indian Annals of Medical Science, No. XV of 1862, (in Norman Chevers's Medical Jurisprudence, third edition, of 1870, p. 464) actual recovery seems to have been demonstrated, by dissection, a long time after the injury.

When
bleeding is
slow, sur-
vival much
prolonged.

d.—When hæmorrhage, though copious, takes place slowly, owing to insensibility, or other cause, the period of survival seemed much longer than in cases of ruptures, of similar extent, when no such cause intervened.

(Case No. 10, spleen split in two ; insensibility ; survival for five hours ; a clot blocked up wound.)

When
bleeding
copious.

When hæmorrhage is copious in amount, the period of survival depends on the rapidity with which the bleeding goes on.

It has been seen, in Table VI, that, ordinarily, ruptures of the spleen survive for periods varying from half-an-hour to several hours. These seem, essentially, cases of bleeding to death, more or less slowly.

When
bleeding
sudden and
copious.

e.—When, from the extent of the rupture, there is sudden and copious gush of blood, death is more or less immediate. In some cases, though the rupture has divided the spleen into halves, yet, if a state of insensibility limit the hæmorrhage, by depressing the

circulation, survival is comparatively prolonged (Case No. 10).

The immediate death is, probably, due to copious and sudden loss of blood ; to the shock, to the nervous system, from this hæmorrhage occurring into the peritoneal cavity ; and, perhaps, to the direct shock of rupture of an important viscus.

Judging from the periods of survival, and from *post mortem* evidences of the immediate mode of death, the direct shock, from rupture of an important viscus, seems not to have influenced the course of the cases, to anything like the degree that might be expected, from *à priori* reasoning, to occur.

All through these cases, one is constantly struck by the absence of marked symptoms due to the injury proper, which the spleen has sustained (especially when there was little or no hæmorrhage, to cause its own train of symptoms).

The most striking instance of this, is Case 35, in which the spleen tissue was most extensively shattered, but the intact capsule prevented exit of blood, and opposed a limit to the amount of hæmorrhage inside it.

There was no marked collapse, after the injury ; and, for four days, no graver symptom than local pain, some weakness, and a rise, of two degrees, in the temperature of the body.

Yet, when the capsule gave way, at the end of the fourth day, death was instantaneous ; and

dissection revealed the true gravity of the prime injury.

(II.)—*Notes on the operation of removal of the spleen.*

Many cases
died from
hæmorrhage
merely.

It will be observed that, among these thirty-nine cases, very many, which survived for periods from several minutes to several hours, appear to have died, practically, from uncontrolled hæmorrhage, from the ruptured spleen, into the abdominal cavity; they, in fact, bled to death.

Most of the present cases occurred in the district, away from the station, and only came under the writer's observation when sent in, dead, for *post mortem* examination.

Symptoms
showing
severe
blood-loss.

The supposition seems probable, that, had these cases come under observation immediately after the injury, the symptoms of severe and continuous hæmorrhage would have been observed to have been marked, in many of them.

Would
early
removal of
spleen
have saved
these cases?

In such cases, considering the impossibility of stopping the bleeding by other, and less grave, means, and the necessarily fatal result of the continuance of this bleeding, would it not have been justifiable—if not imperative—to have performed the operation of ligature of the splenic vessels, and removal of the spleen?

The main
symptoms
depend on
hæmorrhage.

From what has been said previously, in the present chapter, with regard to survival, it will be seen that the severity of the symptoms, the period of survival,

and the mode of death, in uncomplicated cases of rupture of the spleen, depend, chiefly, on the degree of hæmorrhage which takes place, from the rupture of the spleen, into the abdominal cavity ; and that, if little or no bleeding results, the symptoms are, usually, slight, or negative. Very few cases appear to have had severe symptoms, due to shock merely, apart from hæmorrhage.

Case No. 35, remarkably illustrates this. The man survived, for four days, extensive shattering of the spleen tissue inside the unruptured capsule. The capsule remaining entire, its capacity for distention limited the blood loss—(*i. e.*, the amount effused inside this capsule), and no blood escaped into the abdominal cavity.

Bleeding slight—symptoms slight.

Case No. 35 :—No bleeding into cavity of abdomen.

Case No. 14, also, illustrates this point. A rupture of the spleen, from which only a few drops of blood had escaped into the abdominal cavity, was in process of recovery, all the period of danger from the spleen wound (shock, hæmorrhage, peritonitis) having passed, during the five days of survival. The man died of lung, and heart, complications.

Case No. 14 :—Slight bleeding from the ruptured spleen.

The main and most pressing danger, then, in cases of rupture of the spleen, is from hæmorrhage into the abdominal cavity ; and to prevent this hæmorrhage, or limit it, is to prolong the period of survival, or save life.

Main danger is hæmorrhage.

On these grounds, the operation of ligature of the vessels of the spleen and removal of that viscus, is

Operation of removal of spleen

is theoretically advisable.

Conditions justifying the operation.

to be advocated theoretically. Doubtless, these cases of rupture of the spleen present, oftentimes, during life, great difficulties in the way of diagnosis; and the operation is not one which it would be justifiable to undertake, except as a last resort, and as the only means which presented a chance of averting certain, and imminent, death.

Proportion of cases which presumably perished from blood-loss.

It will be seen, from Table VI, that, of twenty-six cases, eventually fatal, (in which the period of survival was known), five were immediately, or almost immediately, fatal; of the twenty-one other cases, fourteen survived, for periods varying from half-an-hour to seven hours; while, four cases survived, for some days.

Cases of rapid death.

In those cases which were immediately fatal, death may have occurred from shock, or from overpoweringly copious, and sudden, hæmorrhage.

Cases of survival for some days.

In those cases which survived for some days, death was due to, or greatly influenced by, the injuries of some other viscera,—heart, or lungs.

In 14 cases, probably, death due to bleeding.

But, probably, most of the fourteen cases (*i. e.*, more than one-half of the total cases under review), which survived for periods from half-an-hour to seven hours, died from the hæmorrhage from the spleen wound, and might, perhaps, have been saved, could this hæmorrhage have been controlled.

Chances of saving these by the operation.

Had it been possible to have performed the operation of removal of the spleen and ligation of its vessels, in the above cases, there seems great reason to think that, in some, at any rate, the continuous,

and eventually fatal, hæmorrhage might have been arrested, and the fatal termination averted.

It is seen that these cases, left to themselves, all proved fatal.

If, after receiving a blow over the region of the spleen, a person is, manifestly, sinking from internal blood-loss, and death appears imminent, the weight of authority is in favour of the performance of the operation of ligature of the splenic vessels and removal of the spleen.

Practical rule of condition which justifies the operation.

Still, unless the symptoms be so clear that the diagnosis amounts almost to a certainty, few, perhaps, would undertake so serious an operation.

Difficulty of certain diagnosis.

The operation has been performed, on many occasions, successfully, on the lower animals, dog, &c., by Heister, Vallisnieri, and others; the patients have made good recoveries, and have lived without any evidence of important derangements of the vital functions.

Success of the operation on the lower animals.

In man, portions of the spleen, which have been injured, or found protruding from wounds of the abdomen, have been removed, by excision, without serious result—good recoveries following.

In man, removal of portions of the spleen successfully.

Three historical cases, of successful removal of the entire spleen, are on record.

(a.) The case of a man wounded at Dettingen. The spleen was found protruding, and covered with dirt; it was excised. The man recovered.

In man, removal of entire spleen.

(b.) A case is published, in *Anatomy and Physiology* by J. and C. Bell, 4th edn., p. 352.

Three historical cases.

(c.) A third case from Fortanus, by Morgagni, is on record, in which the woman survived for five years.

Nine cases in recent times. In two, successful.

Nine cases have been analysed, by Dr. Tanner (*Medicine*, Vol. II, p. 150), in which the operation has been performed, in modern times ; in two cases, successfully—Schultz's and Péau's cases.

Fifteen cases by Professor Adelman.

Fifteen cases, of removal of the whole of the spleen, have been collated, by Professor Adelman, of Berlin, (*Deutsche Klinik*, of the 26th April, 1856). In these fifteen cases, the operation was, successfully, performed for various diseases and injuries.

Successful case by Schultz.

In the successful case, by Schultz, above noted, the entire spleen protruded through a wound, and was removed.

Successful case by Péau, for disease.

In Péau's successful case, the entire spleen was removed, from a lady, twenty years of age, on account of cystic disease and hypertrophy. The above-mentioned cases are noted in Norman Chevers's work on *Medical Jurisprudence in India*.

Nature of above cases. Diagnosis clear.

In these cases of partial, or complete, removal of the spleen, in the human subject, the operation has been performed, usually, for injuries of a spleen which has been partially, or wholly, protruded through wounds in the abdominal walls—or for diseases ; in such instances, the diagnosis, and the indications and necessities of the case, have been clear.

No case for internal rupture of spleen.

The writer is unaware of any instance, on record, of the operation having been undertaken, in cases of internal hæmorrhage, from rupture of the spleen, when

there was no wound through the parietes of the abdomen, and when, therefore, the diagnosis of the case did not amount to, or approach, certainty—the existence of internal hæmorrhage being, indeed, only inferred from the symptoms.

This operation, when undertaken for the control of internal hæmorrhage from a ruptured spleen, would be performed under very different, and more disadvantageous, conditions, than when performed for the extirpation of a spleen, on account of cystic disease (as in Péau's case.)

Operation more disadvantageous when for internal bleeding.

In a case of rupture of the spleen, the operation would not be undertaken until sufficiently extreme hæmorrhage, had taken place, to produce unmistakable and urgent symptoms of copious blood-loss; in which case, much blood must have, already, escaped into the abdominal cavity—the presence of which effused blood would be highly likely to set up peritonitis, and ensure a fatal ending.

In this case much blood effused in abdominal cavity, before operation.

In the other set of cases, in which the operation has been performed, *viz.*, when the whole, or a portion, of the spleen has protruded through a wound of the abdominal walls, and has been injured, or covered with dirt, the protruding and injured portion, or the whole, has been excised, as a lesser evil than returning the injured viscus into the abdominal cavity. In these cases, we repeat, the operation has not been undertaken *ab initio*; the diagnosis has been complete and certain; the injured spleen has lain before the

When performed for removal of protruding, injured, spleen; diagnosis certain; necessities of case clear.

eyes, and under the hands, of the operator, and there has been no difficulty, therefore, in coming to a decision as to the nature of the case, and its necessities.

Draw-
backs to
operation
in cases of
rupture of
spleen.

To undertake the operation, *ab initio*, for inferred internal hæmorrhage from a rupture of the spleen whose presence is, also, a matter of inference from the symptoms, is seen to be an affair of entirely different complexion.

And, if the rupture of the spleen does exist, there is the disadvantage of much blood having, already, been effused, into the abdominal cavity, to prejudice the chances of recovery.

Difficulty
of deter-
mining its
necessity.

The real difficulty lies, not in the performance of the operation, but, in deciding in what cases it is justifiable, and offers a tangible chance of preservation of life.

CHAPTER VIII.

Head VI.—Injuries of other Viscera complicating Injuries of the Spleen.

TABLE VII.

Analysis of 39 cases of Injury to Spleen, with regard to Injuries of other Viscera.

| | | | |
|---------------------------|-----|-----|----|
| Cases of injury to spleen | ... | ... | 39 |
| Other viscera injured in | ... | ... | 13 |

A.—BRUISES OF SPLEEN 4.

| | | | | |
|------------------------------|-----|---|-----|---|
| 4 Cases | ... | { Other viscera injured in | ... | 2 |
| | | { Not injured in | ... | 2 |
| In 2.—Other viscera injured. | { | No. 38 from Fall.—Distended stomach had two ruptures. Stomach full. | | |
| | { | No. 33 from Blows (pounding). Left lung bruised and congested. | | |

B.—RUPTURES OF SPLEEN-SUBSTANCE, CAPSULE } INTACT (CLASS II) ... } 1.

1 Case.—No other viscera injured.

C.—RUPTURES OF SPLEEN (CLASS III), CAPSULE, } AND SUBSTANCE BOTH RUPTURED AT TIME } 34. OF INJURY ... }

(a).—In 11—Other viscera injured ... 11

| | | | | |
|------------------|---|--|--|--|
| In 2, by gunshot | { | Case 11.—Stomach, colon, small intestine, pierced by a ball. | | |
| | { | Case 12.—Stomach, and liver, pierced by a ball. | | |

In 9, *by Falls, or Blows.*

| | | |
|---|---|--|
| In 4, the viscera ruptured. | { | Case 30.—By Fall; lungs, both, pierced by broken ribs. All the left, and five right, ribs broken. Kidney ruptured. |
| | | Case 10.—By Fall; lung, left, ruptured by shock, and congested. Stomach full. |
| | | Case 21.—By Fall; pleura, left, pierced by broken rib. 5 left ribs broken. |
| | | Case 1.—By Blow (hand); colon ruptured, at junction of transverse and descending portion. Stomach full. |
| In 5, the viscera not wounded, but bruised. | { | Case 13.—By Fall; lungs, both, scarlet on surface, from bruise. |
| | | Case 14.—By Fall; lungs, both, congested; and endocarditis. |
| | | Case 17.—By Fall; lungs, both, congested, superficially. Stomach full. |
| | | Case 31.—By Blow { Lung, right, congested. |
| | | (bamboo); { Pleura, effusion into both. |
| | | Case 25.—By Blow { Lung, left, congested |
| | | (pounding); { severely. |

(b).—In 23 cases—Other viscera not injured.

From Table VII, we gather, that :—

(Omitting the two cases of gunshot injuries, as beyond the scope of the present paper)

Proportion
of cases of
injury of
other vis-
cera.

Of 37 cases of injury to the spleen—
in 11, other viscera were injured ;
in 26, no other viscera suffered.

Viscera
wounded or
bruised.

Of these 11 cases—
in 5, other viscera were wounded ;
in 6, they sustained bruises.

Propor-
tion of
cases.

Other viscera were injured in 1 out of $3\frac{1}{11}$ total cases.
The ratio, of cases in which other viscera were injured,
to cases in which they were not injured, was 1 to $2\frac{4}{11}$.

Propor-
tion in
Bruises.

Of 4 cases of Bruise to Spleen—
in 2, were other viscera injured ;
in 2, there were no such injuries.

Of 33 cases of Rupture of the Spleen, by Falls, or Blows (Classes II, and III).

in 9, were other viscera injured ;

in 24, there were no such injuries.

Proportion in Ruptures.

That is, in cases of *rupture* of spleen (Class II, or III), other viscera were injured in 1 in $3\frac{2}{3}$ cases.

Of these 9 cases—

4 were *wounds* of other viscera ;

5 were *bruises* of other viscera.

Proportion of Wounds and Bruises.

Of the 4 cases of *wound* of other viscera—

in 2, they were caused by broken ribs ;

in 2, they were caused by rupture from shock.

Of the 37 cases of injury (*rupture, or bruise*) of spleen, under review, (Gunshot cases omitted)—

Proportion of Falls and Blows in total cases.

19 were caused by Fall

16 by Blows.

Of the total 11 cases, of injury to other viscera—

7 were by Falls ;

4 were by Blows ... { one, by hand,
two, by pounding,
one, by bamboo.

And in Injuries of other Viscera.

Thus a total of 19 cases, by Fall,

had 7 cases of injury to other viscera ;

i. e. 1 in $2\frac{5}{7}$.

In Falls, 1 in $2\frac{5}{7}$.

A total of 16 cases caused by Blows,

had 4 cases of injury to other viscera ;

i. e., 1 in 4.

In Blows, 1 in 4.

This is what might be supposed likely to occur, in consequence of the greater violence of the shock in

Comment.

Falls, commonly, than in Blows. These cases of injury to other viscera occur nearly twice as often in cases caused by Falls, as in those caused by Blows.

Which viscera injured—

Of 11 cases in which other viscera suffered—it was

Which
other
viscera
injured.

| | | |
|-----------------------------|-------|-------------------------------|
| <i>Lungs, or Pleura, in</i> | ... 9 | } (Gunshot cases omitted). |
| <i>Stomach, in</i> | ... 1 | |
| <i>Colon, in</i> | ... 1 | |

The *Heart* suffered, with *Lungs*, in one case.

The *Kidneys* suffered, with *Lungs*, in one case.

5 Wounds

Of the 11 total cases—5 were Wounds.

6 Bruises.

6 were Bruises.

In the 5
wounds,
which
viscera
suffered?

Of the 5 cases of Wounds, these were on

| | | |
|---|---|-----------------------------------|
| <i>Lungs, or Pleura, in</i> 3 cases. | { | 1 Lung pierced, by broken ribs. |
| | | 1 Lung ruptured, by shock. |
| | | 1 Pleura pierced, by broken ribs. |

Stomach, in 1 case.

Colon in 1 case

In the 6
Bruises,
Lungs
suffered, in
all.
In one, the
Heart also.
Wounds—
by Fall or
Blow.

Of the 6 cases of Bruise—

The *Lungs* were the viscera injured, in all. In one case, the *Heart* also, suffered.

Of the 5 cases of Wound of other viscera,

4 were caused by Fall ;

1 was caused by Blows (by hand).

Of the 6 cases of Bruise of other viscera,

3 were caused by Fall

| | | |
|------------------------|---|--------------------------------|
| 3 were caused by Blows | { | 1, with a bamboo. |
| | | 2, by pounding with knees, &c. |

Thus, in cases in which other viscera suffered the graver injury of rupture, four, out of five, were caused by the severer shock of falls.

Wounds
proportion
by Falls.

In cases in which other viscera suffered the lesser injury of bruise, three were caused by falls, three by blows (*viz.*, one by blows with bamboo stick, two cases by pounding by feet, knees, &c., of assailants).

Bruise of
other
Viscera—
half were
by Falls—
half by
Blows.

Conditions especially inducing Injuries of other viscera.

Conditions.

(A.) *Internal causes.*

(a.)—*Firm condition* of the Spleen

Firmness
of Spleen.

In two cases, Nos. 1, and 38, the firm, hard, condition of the spleen was mainly instrumental in, itself, inflicting the injuries on the other viscera.

In Case No. 1, the spleen was of firm consistency, and the colon was ruptured just in the region in which the lower, pointed, end of a normal spleen should be in contact with it, *viz.*, at the angle of junction of transverse with descending portion.

Cases
illustrat-
ing this.
Case No. 1.

The colon seems to have been ruptured by the concussion against this hard point of the firm spleen. Had the spleen been soft in consistency, this rupture of the colon would, probably, not have occurred. The stomach was distended at the time of injury.

Firm
spleen.
Its lower
end ruptur-
ed colon.

In Case No. 38, the stomach, distended and hard with food, was ruptured on that face which lay in contact, and came into collision, with the firm spleen. No doubt, the firm condition of the spleen deter-

Case No.
38: Full
stomach
ruptured
against a
firm
spleen.

mined the rupture of the contiguous, hard, full, stomach. Had the spleen been soft, it would, in all probability, have, itself, suffered rupture, while the stomach would, presumably, have escaped.

In neither case, did the firm spleen, itself, suffer rupture at the region of contact with the other injured viscus ; though, in Case No. 38, it was bruised at that region.

In similar cases a diseased spleen always ruptured.

In every other case (seven, in all), in which the distended stomach came into collision with a more or less diseased, or even a healthy, spleen, this spleen suffered rupture, and the stomach escaped.

(b.)—*Influence of a state of fulness of the stomach.*

Proportion of cases of full stomach, and empty stomach, in cases of injury to other viscera.

Of the eleven cases of injury to other viscera, in four the stomach was recorded as full ; in one, it was recorded as empty ; in the other six, its condition was not recorded. In these four cases in which stomach was full, in two, the lungs suffered injury ; in one, the colon ; in the fourth case, the stomach itself was ruptured.

From these facts, we may conclude that, in cases of violent concussions to the body, a full stomach is a source of danger, not only to the spleen, but to itself, and to the other viscera.

Rupture of colon, and of stomach, due to internal causes.

The injuries to colon, and to stomach, in Cases Nos. 1, and 38, have (Chapters V, and VI) been shown to have been due to internal causes, *viz.*, the firm condition of the spleen, and the distended, hard, condition of the stomach, in each case.

(B.) External causes.

The nature of the violence, and the region on which this impinges, must, naturally, exercise much influence in the production of injuries to such organs as the lungs, and pleura, which furnish nine, out of the total eleven, cases, in which other viscera (besides spleen) were injured (gunshot cases omitted).

Region on which violence impinges determines causation of injuries.

The production of injuries of the lungs, probably depends, almost entirely, on these external causes—the violence of the concussion, and its impinging directly, on some portion of the chest.

Especially to chest viscera.

It will be noticed, that, in eleven cases, in which injury to other viscera occurred, the lungs, or pleura, suffered in nine; the abdominal viscera, in only two; stomach, in one; colon, in one.

Proportion—chest, abdominal, viscera.

Again, the abdominal viscera seem, in both cases, to have suffered on account of internal causes, such as the condition—as to hardness, distention, &c.,—of contiguous abdominal organs, such as the spleen, and stomach.

Abdominal viscera suffered from internal causes.

The lungs, and pleura, suffering in nine, out of eleven, cases, seemed always injured from the direct impact of the concussion on the chest (sometimes, through the instrumentality of the jagged ends of fractured ribs)—that is, from external causes.

Chest viscera suffered from external causes.

In one case, the lungs—in one case the pleura—was pierced by the end of a broken rib.

Lung pierced by rib.

In one case, the lung was ruptured, by shock.

Lung ruptured.

In six cases, the lungs were bruised, or congested.

Lungs bruised.

It will be noted, that the liver suffered in no case.

Liver.

In cases of injury to the spleen, the liability, to injury, of each viscus, will now be separately discussed.

Kidneys. In one case only—No. 30—the kidney suffered.

Injury to other viscera.

a.—The Lungs and Pleuræ.—Table VIII gives an analysis of the cases in which the lungs, or pleuræ, suffered, in 37 cases of injury to the spleen (omitting two gunshot injuries).

TABLE VIII.

Analysis of 37 cases, showing injury to lung, or pleura, in cases of injury to spleen.

Total cases of injury to spleen ... 37 (omitting 2 gunshot cases).

Accompanied by injury to lungs, in... 9

IN CASES OF FALLS (19).

| | | | | | | |
|------------------------------|---|---|----------------------------|---|--|--------|
| Pleura, or lung, injured, in | } | 6 | a.—Bruise, or congestion. | { | 3—Nos. 13, 14, 17.—Both lungs injured in all ... | 3 |
| | | | b.—Rupture of lung. | | 1—No. 10.—Left lung (with congestion) ... | 1 |
| | | | c.—Pierced by broken ribs. | { | 2 { No. 30—Both lungs (kidney ruptured) ... No. 21—Pleura, left | 1 1 |

IN CASES OF BLOWS (16).

| | | | | | | | |
|------------------------------|---|---|---|-----------------------|---|--|---|
| Lung, or pleura, injured, in | } | 3 | { | Bruise, or congestion | { | 3 { No. 31.—Right lung congested ... (both pleura, effusion into) | 1 |
| | | | | | | No. 25.—Left lung congested ... | 1 |
| | | | | | | No. 33.—Left lung bruised, and congested ... | 1 |

IN CASES BY OTHER VIOLENCE (2).

Lung, or Pleura, injured in—none.

From Tables VII, and VIII, we deduce the following statements :—

In 37 cases of injury to the spleen (omitting two gunshot cases)— Lung or pleura suffered—proportion.

in 9 cases, the lung, or pleura, also suffered ;
 in 28 cases, the lungs did not suffer injury ;
 that is, the lung, or pleura, suffered in about every fourth case of injury to spleen.

In 11 cases of injury to spleen, in which other viscera were wounded— Lung suffered more frequently than other viscera as 4½ to 1.

in 9 cases, the lung suffered ;
 in 2 cases, some other viscera ;
 showing the lung to have suffered, in these cases, more frequently than other viscera, in proportion as 4½ to 1.

In four cases of *bruise* of spleen, the lungs were injured in one.

Of 35 cases of injury of spleen, by falls, or blows, the lungs suffered in 9. Proportion of lung injuries, in falls.

Of 19 injuries to spleen, by *falls*—
 in 7, there were injuries to other viscera,
 in 6 of these, the lung was the viscus injured.

Of 16 injuries to spleen, by *blows*—
 in 4, there were injuries of other viscera, Proportion of lung injuries, in blows.
 in 3 of these, the lung was the viscus injured.

Thus in total injuries to spleen, by *falls*, the lungs, also, suffered, in nearly one case in three; and, when

any other viscus, besides the spleen, was injured, this viscus was the lung, in six-sevenths of the cases.

Similarly, in injuries to spleen by *blows*, the lung suffered, in nearly one in five cases ; and, if any other viscus, besides the spleen, was injured, this viscus was the lung, in three-fourths of the cases.

In cases of injury to the spleen, of the total number of cases in which the lung also suffered, two-thirds were from *falls*—one-third, by *blows*.

Frequency
of lung
injury in
falls to do,
in blows
as 2 to 1.

In the above cases, therefore, lung injuries were twice as frequent when the spleen was injured by *falls*, as they were when the injury was from *blows*.

This is explained by the fact, that the violence is, ordinarily, more severe and diffuse, in the case of *falls*.

Of 11 cases in which other viscera suffered, in injuries to spleen,—

in 5 cases, the injury to other viscera was *wound*,
in 6 cases, it was *bruise*.

Proportion
of bruises
to wounds
of lung.

Of the above 5 cases of *wound*,
in 3 cases, the lung (or pleura) was the viscus
injured.

Of the 6 cases of *bruise*, in every instance the lung (or pleura) was the viscus injured.

All 3
wounds of
lung
caused by
falls.

In all 3 cases of *wound* to the lung, the injury was by a *fall*,

Thus, *bruises* of the lung were twice as frequent as *wounds* of that organ.

Which lung injured?

Of 9 cases in which the lung, or pleura, suffered Injuries of lung.
Which lung suffered?
—in 4, both lungs were injured, *viz.* :—
 in 1, pierced by ribs ;
 in 3 cases, bruised, or congested.

In 4 cases, the left lung only, suffered, *viz.* :—
 in 2, wounded, *viz.*,
 in 1, pierced by ribs ;
 in 1, ruptured by shock ;
 in 2, bruised, or congested.

In 1 case alone, the right lung alone, suffered.

Of 6 cases of injury to lung, by *falls*—

 in 4 cases, *both lungs* suffered—in 3,
 bruised—in 1, pierced :
 in 2, *the left lung* only, suffered, *viz.* :—
 in 1 case, rupture, by shock,
 in 1 case, pierced by broken rib.

Injury to
lungs by
falls.

Of 3 cases of injury to lung, by *blows*—

 in 2, the left lung only, suffered—in both, bruise ;
 in 1, the right lung only, suffered, bruise.

Injury to
lung by
blows.

Thus, in cases from falls, both of the lungs, most frequently suffered—commonly bruises. In nearly half the total cases (from whatever cause), the left lung only, suffered, and equally frequently, from falls, and from blows. In no case did the right lung alone, suffer from falls.

In falls,
both lungs.
In half the
cases, left
lung only.

In one case alone, did the right lung only, suffer ; this was from blows with a bamboo stick.

Right
lung only.

Proportion—
wound—
bruise—by
fall—blow.

In six cases the lung suffered from *fall*: in three, the injury was a *wound*, *viz.*:—in two, pierced by a broken rib; in the third, ruptured by shock.

In three cases, the lung suffered from *blows*—in all three cases, the injury was *bruise*. This illustrates the greater, and more diffuse, shock resulting from *falls*, as compared with the more localised violence from *blows*.

In 8
out of 9
the
left lung
suffered.

The left lung is seen to have suffered, in eight, out of nine, cases of lung injury, *viz.*: alone, in four cases; with the right lung, in four cases.

From the proximity of left lung to the spleen, we might expect this lung to, frequently, suffer with that viscus.

In one case,
pleura
alone
suffered.
Details.

In only one case, did the pleura alone, suffer, the lung remaining uninjured, *viz.*:—

In Case No. 21, Dobagoo.—From a fall, the left pleura was pierced by the broken end of the third rib. There were five left ribs broken, near their angles, *viz.*: from second to sixth, inclusive. There was Colles's fracture of the right wrist. The large, soft, spleen had three transverse ruptures; two extensive ones, on concave surface—one, on convex. The man survived, for three hours.

Cases
of wound
of lung.

The other two cases of wounds, and six of bruises, of the lung, were the following:—

(a) *Wounds.*

Case No. 30:
Rupture of
spleen, with

In Case No. 30, both lungs were pierced, by broken ribs. All the ribs on the left side, and five on right

side, were broken ; those on the left side, broken through their shafts, often in two or three places ; those on the right side, broken towards their sternal ends.

wound of
lungs by
broken
ribs.

The left lung was pierced, in three places, and its surface was covered with clots. The right lung was pierced by the jagged ends of fractured fourth right rib, and two ounces of blood were found in this pleura.

The spleen was ruptured, longitudinally, from end to end of the convex surface. Both kidneys were injured. The right kidney was ruptured, at hilus, and about half an ounce of blood was effused into the areolar tissue round it. The left kidney was bruised, in several places.

Right
kidney
ruptured.

Left
kidney
bruised.

Ribs may, however, be fractured, without any injury to lung, or pleura, ensuing.

Thus, in Case No. 9, Hurrimul Kolita.—From a fall, the five left ribs, from sixth to tenth, inclusive, were broken, and the convex surface of spleen was torn, in every direction, by their jagged ends. The lungs, and pleuræ, entirely escaped injury, though the jagged end of the eighth rib had pierced the external parietes of the chest—making a wound, through the skin, one inch by half-an-inch.

Case No. 9:
Ribs frac-
tured, but
lung not
injured,
spleen
torn.

The second case in which the lung was wounded, was No. 10, Bhakaroo.—In this case, from a fall, a large spleen was split almost in two, transversely, from concave surface. *Stomach* was distended with a mass of rice. There were several external bruises, but no

Case 10:
Rupture of
lung from
shock.
Spleen split
in two.

ribs fractured. The left lung was severely congested, especially towards the left, and anterior, surfaces. There was a rupture of the surface of the left lung, half an inch long ; a few drops of blood had escaped, and the wound was blocked by a firm clot. The man survived for three hours.

The third case of wound of the lung—No. 21—has been detailed, above.

Six cases
of bruise of
lung.

(b.) *Bruises* :—*In six cases*, the lung was bruised, or congested.

Case No.
13 : Rup-
ture of
healthy
spleen.

Case No. 13, Heho Kolita.—From a fall, a healthy spleen was ruptured, transversely, across convex surface. There were extensive bruises in the tissues over the chest and abdomen. Both lungs were severely bruised, and of a scarlet color on anterior surfaces. The man lived, for six hours, after the injury.

Bruise of
both lungs.

Case No.
14 : Con-
gestion
of both
lungs.

Case No. 14, Woochem.—From a fall, a firm spleen had a rupture, one inch long, one-third of an inch deep, across convex surface. The man survived, for five days ; both lungs were found, on dissection, intensely congested. The endocardium was pink, from injection of its minute bloodvessels.

Endocar-
ditis.
Rupture of
firm spleen.

The man seems to have died from the lung, and heart, complications, as the spleen wound was in stage of recovery—blocked by a firm, semi-organised, clot (*vide* Chapter VI).

Case No.
17 : Lungs
congested.

Case No. 17, Dhorma Kolita.—From a fall, a large, soft, spleen was shattered, on both surfaces, and

showed five ruptures. The stomach was distended with a mass of food.

Both lungs were extensively congested, superficially; dark serum was effused into both pleural cavities. The man lived, for half-an-hour. Spleen ruptured.

Case No. 33, Narah Koiburto.—From pounding with feet, knees, &c., of assailants, a healthy spleen had a bruise, on convex surface, two inches by one inch. The left lung was extensively congested, and its anterior surface pink colored, from ecchymosis. The man lived for four days, and, eventually, died of the lung mischief, which had steadily progressed, in severity, since the infliction of the injury. Case No. 33: Left lung pink; bruise, and congestion. Healthy spleen bruised.

Case No. 25, Budoo Konch.—From pounding with knees, feet, &c., of assailants, the spleen was ruptured, and the left lung intensely congested. Case No. 25: Left lung congested.

Case No. 31, Gomaroo.—From blows with a bamboo stick, a very large and soft spleen was ruptured. There were bruises in the muscles of right side. The right lung was congested. Each pleura contained about eight ounces of bloody serum. The man survived for two hours. Case No. 31: Right lung congested. Effusion into pleuræ.

There were ecchymoses on right costal pleura corresponding to the bruises of the external muscles. Soft spleen ruptured.

Remarks.—The base of the left lung, and the upper end of the spleen, are only separated by the diaphragm. From the proximity of these two viscera, and their both being on the same side of the body, Left lung in proximity to spleen. Both suffer from same shock.

the left lung tends to participate in the shock, when violence falls on the left rib-region.

Lungs
suffered, in
one case in
four :

We find, by reference to Table VIII, that, in thirty-seven cases of injury to spleen, the lung (or pleura) suffered in nine, that is, roughly, in one-fourth, only, of the cases.

Left lung. The left lung suffered, in eight cases, out of nine, of lung injury, *viz.*:—in four cases, alone—in four cases, with the right lung.

Right lung. The right lung alone, suffered in only one case, out of nine. Both lungs, together, suffered in four cases; all these were from falls—three, bruises, one, wound.

Six out of
nine in-
juries of
lung—by
falls.

In falls, we see that the shock is severe and diffuse; of six cases of injury, to lung, so produced, three had bruises of both lungs; three had wounds of the left lung, or of both—*viz.*:—two pierced by broken ribs, one ruptured from shock.

Thus, we see how frequently the violence which injures the spleen injures, also, the left lung, if any lung injury occur.

Lung
injury was
to left
lung in
eight-
ninth of
the cases.

Of 37 total cases of injury to spleen (omitting two cases of gunshot), in eight, the left lung (contiguous to spleen) suffered, while the right lung suffered, in one, only.

Rarity of
rupture of
lung by
shock.

It is also worthy of notice, how rare is rupture of the lung tissue from shock, and how frequent, such rupture is, in the spleen.

Frequency
of rupture

Thus, in 37 cases of injury of the spleen (omitting

two by gunshot), in 31 (omitting two cases, in which of spleen, from shock. spleen was torn by broken ribs, or by a tiger), *rupture* occurred from the shock, or collision, resulting from the violence ; while, of all the 37 cases, in only one did the lung tissue rupture (and that slightly) from the shock of the violence.

It is seen that, while the spleen suffered the major injury, of rupture, in nearly eight cases out of nine in which it was injured, the lung suffered this major injury, in only one case in nine in which it was injured.

The production of injuries to the lungs is deter- Production of lung injuries is from external conditions. mined, almost entirely, by external conditions, such as the severity, and diffuseness, of the violence, and its impinging over the region of the chest. The internal conditions—such as the state of hardness, distention, &c., of spleen, or stomach—on the other hand, have most weight in determining injuries of the abdominal viscera.

In many cases, the bruises of the external tissues and muscles over the region of the lungs, show that the chest walls have sustained much the same violence which has sufficed to rupture the spleen, and, yet, no injury to the lung has been sustained. Cases in which lung has resisted, unhurt, violence sufficient to rupture spleen, and injure chest wall.

The present cases show eleven such (*i.e.*, external bruise without lung injury) instances of severe bruising of tissue of chest wall ; in one case, too, five left ribs were broken, and the eighth rib had pierced the parietes ; yet, in none of these cases, was there any lung injury.

The lungs, then, frequently escape injury, when violence, sufficient to rupture the spleen, and cause severe injury to parietes, has impinged over their region also.

Reason of
the lung's
power to
escape in-
jury.
Structure.

The reason of this capability of the lungs to resist rupture, is, probably, to be found in their toughness, and elasticity, of structure ; in their ready, and extreme, compressibility—being distended with easily expelled air ; and, in their being, at all times, well protected by the ribs—themselves moveable—within whose bony framework, they are, at all times, entirely enclosed : they cannot, thus, move from their natural protections into positions of danger—as the spleen does in enlarging.

Position.

Influence
of lung
complica-
tion on
survival.

Influence, of lung complications, on survival, in cases of injury to the spleen.

In the nine cases, above-mentioned, of injury to lungs in cases of injury to spleen, the periods of survival were :—

| | | | |
|--|----------------------------|-----|------------------------|
| Periods of survival in 9 cases of lung com- plication. | <i>Cases 25, and 30...</i> | ... | Unknown. |
| | <i>Cases 10, and 21...</i> | ... | 3 hours. |
| | <i>Case 17</i> ... | ... | $\frac{1}{2}$ an hour. |
| | <i>Case 31</i> ... | ... | 2 hours. |
| | <i>Case 13</i> ... | ... | 6 hours. |
| | <i>Case 14</i> ... | ... | 5 days. |
| | <i>Case 33</i> ... | ... | 4 days. |

Lung inju-
ry does
not cause
rapid
death ;

but ensures
fatal result.

We must, therefore, conclude, that the addition of the lung injury did not seem to cause a quickly fatal ending ; though the injury to the lung tends to produce congestion, of a steadily progressive severity, which, when advanced to a certain pitch, ensures an

eventually fatal ending to the case, should the injured person survive the spleen injury sufficiently long to allow the lung mischief full scope.

In Cases Nos. 14, and 33, these two characteristics of lung injury are, both, well illustrated.

In Case No. 14, the spleen rupture seemed on the road to recovery ; the dangers from shock, from hæmorrhage, and from peritonitis, had passed—the patient having survived, for five days. Cases illustrating this:—Case No. 14.

The progressively increasing double congestion of the lungs (together with the endocarditis) seems to have ensured the fatal ending.

In Case No. 33, too, the bruise of the spleen seemed of no marked influence as a cause of death. The bruise of the left lung did not cause any rapidly fatal result, but, the consequent congestion steadily, though slowly, progressed, in severity, through the four days of survival, causing death when it reached its climax ; and, thus, ensured an eventual, though delayed, fatal termination. Case No. 33: Bruise of spleen ; lung injury, killed in 4 days.

These characteristics of injuries to the lung are quite in accordance with all we know of the physiology, and behaviour, of that viscus.

b.—Injuries of the stomach complicating injuries of the spleen.

Of 37 cases of injuries to the spleen (omitting two gunshot cases) :— Proportion of cases,

in 11, there were injuries to other viscera ;

in 1 of these, only, was the stomach this injured viscus.

Influence
of condi-
tion of
stomach.

The great influence which the condition of the stomach, as regards its hard distention, or elastic emptiness, has in influencing the production, and nature, of injuries to the spleen, has already been discussed. (*Vide* Chapter V.)

Distended
stomach
dangerous
to diseased
spleen.

It has been shown, that when the stomach is distended and hard with food, it is a dangerous neighbour to the spleen, especially if this latter be enlarged, and softened, or friable, in structure. It has been seen that when the two viscera, in the above-mentioned

These two
in collision.
one or both
suffer;
usually
spleen.

state, are brought into violent collision, one, or both, may suffer on the face of contact. The one to suffer is, ordinarily, the spleen; almost invariably so, if this be soft, or friable; and it is, in these circumstances, sometimes shattered by multiple ruptures (in Case No. 17, 5 ruptures; in Case No. 6, 3 ruptures; some on each surface), or split more or less completely into two parts (in Case No. 10), or shattered to pieces inside the intact capsule (in Case No. 35); the nature of the injury depending on the degree of disease of the spleen.

Cases
referred to
in which
spleen so
suffered.

Distended
stomach
and
healthy
spleen in
collision.

When a distended, hard, stomach, and a healthy, firm, spleen, are brought into collision, the spleen offers greater resistance, and both may suffer injury.

Such appears to have been the case in the only one, among thirty-seven cases of injury to spleen (omitting gunshot injuries), in which the stomach suffered from the violence—sufficient, in each of the cases, to bruise, or rupture, the spleen.

In this case—No. 38—Shombaroo, ætat 19, fell from a platform, 8ft. 3in. high, to the ground, on to left side of the body ; the left side of abdomen, about level of the umbilicus, impinged against a blunt bamboo stump. The man died, after an interval of seven hours.

Case
No. 38 :
Rupture of
stomach
against a
firm
spleen.

A skin wound was found on left side of abdomen where the stake had struck the body, and much ecchymosis existed in the tissues and muscles round, and beneath, this.

Details—
By Fall.

The spleen was healthy and firm, and lay entirely behind the left lower ribs ; on its concave surface, below the hilus, was a bright red bruise, about 2 inches by 3 inches, and extending about $\frac{1}{3}$ inch into the substance of spleen. This was on the internal surface, where spleen was in contact with the stomach. No other injuries of this viscus.

Spleen,
healthy.
Bruised on
internal
surface.

The stomach was still distended with a large meal of rice ; at its cardiac extremity, where it lay in contact with the spleen, were two ruptures through its coats, each large enough to admit the forefinger. The coats of the stomach showed no signs of ulceration or disease, and were as thick at the margins of the ruptures as elsewhere. Round the region of the ruptures, the mucous membrane was ecchymosed, for about two inches in extent, as was the serous coat (outer surface), for about half an inch. A few grains, only, of rice had escaped into the cavity of the abdomen, as had, also, a few drops of blood.

Stomach
distended,
two rup-
tures at
cardiac
end ;
its coats
healthy.

Ecchy-
mosis
round
margins of
ruptures.

The contents of stomach, at the cardiac end, were tinged with blood.

Survived
for 7 hours.

The man survived, for seven hours. He did not seem (from the full state of stomach, found on dissection) to have suffered from vomiting. Very little blood escaped from the wounds of the stomach. He died of collapse.

Died of
collapse.

In this case, in which the coats of the stomach were crushed between the mass of contained rice on the inside, and the firm spleen on the outside, the result usual in such collisions with a soft spleen was reversed : the stomach, itself, suffered double rupture, whilst the firm spleen escaped with only the slight injury of bruise.

Cases of
gunshot
injury.

The following two cases of gunshot injury of spleen, and stomach, are interesting, for comparison :—

Case
No. 11 :—
Wound of
colon,
small in-
testine,
spleen, and
stomach.

Case No. 11, Motia Cachari, ætat 40, was shot through the abdomen, with a ball, out of a smooth-bore. The bullet entered the left side, below 11th left rib, pierced the descending colon, some coils of small intestine (jejunum), through the spleen, and the cardiac end of stomach, and, finally, made its exit from the body through the shattered cartilage of the 9th right rib.

Survived
for 4 hours.

The man survived these extensive injuries, for four hours.

Case
No. 12 :—

Case No. 12, Shonkeng, woman, ætat 35, was shot through the abdomen, by a ball, out of a smooth-bore gun.

The spleen, stomach, and liver, were pierced. Wound of spleen, stomach, liver.
 Period of survival, not known. The ball passed through the liver, from right to left, and completely shattered the thin left lobe. The wound of stomach was 3in. long, and looked as if a piece had been gouged out.

Influence, on survival, of complicating injuries of the stomach.

In cases of injury to the spleen, it is difficult to say how far the addition of the injury of stomach may affect the period of survival.

In Case No. 38, the two ruptures of the stomach Case No. 38 :— (and consequent escape of some of its contents Lived for 7 hours. into peritoneum) were, doubtless, the main causes of death—still they permitted the man to live for seven hours.

Again, in Case No. 11, the man lived, for four hours, Case No. 11 :— with stomach, spleen, and intestines, shot through. For 4 hours.

That such cases will, eventually, end fatally, there is Influence— little doubt, but, as a matter of observed fact, the doubtful— two, above-mentioned, cases were not as quickly fatal discussed. as the severity and extent of the injuries might lead one to suppose probable.

Had the wounds been more extensive, and had a large quantity of the contents of the stomach escaped into the peritoneal cavity, perhaps quick death, from shock, would have taken place—as it would have done, if the wounds had involved any large bloodvessel, and been accompanied by hæmorrhage.

Why does
stomach
usually
escape?

Why does the stomach, almost invariably, escape injury, in cases in which, by coming into collision with this viscus in a distended state, the spleen is, so frequently, shattered ?

Spleen only
encroaches
on stomach
when
diseased.

The reason, probably, is, that it is only when the spleen is in an enlarged condition that it encroaches, to any extent, on the space ordinarily occupied by the stomach while in a distended state, and that it tends to thrust that viscus forward.

In all the cases herein considered, the enlargement of the spleen was malarial, and was accompanied by increased softness, and friability, of its substance. When, therefore, the shock of violent collision comes, the softened spleen suffered the fate of the weaker.

Cases—
firm
spleen—
full sto-
mach.

In three cases, a firm, more or less healthy, spleen suffered on its concave surface (of contact) from being driven against a distended, hard, stomach.

(Cases Nos. 1, 6, 38.)

Case No.
38.

In Case No. 38, the stomach suffered more severely than the spleen, and was ruptured in two places, while spleen escaped with bruise only—both injuries being on the surfaces of contact.

Case No. 6 :
—Spleen
ruptured
on convex ;
full sto-
mach un-
injured.

In Case No. 6, the firm spleen was ruptured, in two places, on the concave surface (next to stomach), and, in one place, on the convex surface—while the distended stomach entirely escaped injury.

The extreme violence of the shock (a blow, over

spleen, with a massive wooden-mallet), probably accounts for the extent of the injury to spleen ; but how escaped the hard, distended, stomach, against which the firm spleen was crushed ?

The escape of the stomach, in this case, as in others, may be, to some extent, due to the mobility of the pyloric region of the viscus, and its capability to yield, somewhat, in this direction, even when the distended, bulging, cardiac region is, more or less, fixed between the abdominal wall, the posterior pillars of the diaphragm, and the spleen.

In Case No. 1, again, the stomach was distended ; the spleen slightly enlarged, but firm. The violence was by blows with the hand. The firm spleen was ruptured on that surface (concave) in contact with the full, hard, stomach—(fissure $2\frac{1}{2}$ inches, long, and $\frac{3}{4}$ inch, deep). The stomach entirely escaped injury, though the shock was sufficiently severe to, not only, rupture the firm spleen, but also to cause rupture of the colon, at the region where the angle of junction of the transverse and the descending colon is in contact with the lower, pointed, end of the spleen.

To what cause soever it may be due, the fact remains, that the stomach enjoyed, in the present cases, an almost complete immunity from injury, even when it was in such a state of hard distention as to, apparently, have inflicted rupture (or bruise) on the contiguous diseased, or healthy, spleen.

In the present 37 cases (omitting 2 gunshot), in

Why did
stomach
escape ?

Its posi-
tion—and
mobility.

Case No. 1:
—Firm
spleen rup-
tured on
concave.

Distended
stomach
escaped
injury,
colon
ruptured.

Escape of
stomach.

Proportion
of cases.

13, the condition of the stomach, as regards distention, or emptiness, is recorded.

Of these 13,

| | |
|-------------------|---------------------------------|
| Stomach full. | in 8, stomach was <i>full</i> , |
| Stomach empty. | in 5, ditto do. <i>empty</i> . |

| | |
|---|---|
| Which re- gion of spleen suffered. | Of the 8 cases in which stomach was <i>full</i> ,—in 6, the concave surface (of spleen) suffered, (with convex, in 2); in no case, the convex only. |
|---|---|

Of the 5 cases in which stomach was *empty*, in 3 (probably 4), the convex suffered, in one only, the concave.

Proportion. Thus, in cases of injury to spleen—

when stomach was *full*,

| | |
|---|---|
| Concave to convex— stomach full. | the concave (of spleen) suffered $\frac{3}{4}$ ths of the cases, the convex, with concave, in $\frac{1}{4}$ th of cases, the convex only, in none ; |
|---|---|

| | |
|-------------------|---------------------------------|
| Stomach empty. | when stomach was <i>empty</i> , |
|-------------------|---------------------------------|

the concave suffered in $\frac{1}{5}$ th of the cases,
the convex, in $\frac{3}{5}$ ths, or $\frac{4}{5}$ ths, of cases.

It is seen that, in cases of injury to the spleen, when stomach was distended with food, this injury to spleen was on the concave surface (*i. e.* the one in contact with the full stomach), in a far greater proportion of cases, than it was on the convex (external) surface of spleen.

Ratio. For, when stomach was *full*—

| | | | | |
|---|-----------------------------------|------------|------------------------------------|--------------|
| Concave to convex. Stomach full. | frequency of injury to concave | } was to { | frequency of in- jury to convex | } as 3 to 1. |
|---|-----------------------------------|------------|------------------------------------|--------------|

When stomach was *empty*—

Stomach
empty.

frequency of injury } was to { frequency of in- } as 1 to 4.
to *concave* } jury to *convex* }

Also,

frequency of injury } was to { frequency of in- } as 4 to 1,
to *concave* when } jury to the same } nearly.
stomach *full* } surface when }
stomach *empty* }

The conclusion is, that injury to the concave sur- Conclusion.
face was nearly four times as frequent in occurrence,
when stomach was full, as it was when that viscus
was empty.

We must, then, admit that the hard, distended, Full
condition of the stomach was, frequently, the deter- stomach
mining cause of injury to the concave surface of the caused
spleen. injury to
concave.

In Chapter V, too, it is shown that the distended Do. do.
condition of the stomach (from food) was, in all pro- primarily
bability, the cause why, in certain cases, any injury causes in-
whatsoever occurred to the spleen (Cases Nos. 1, 14, jury.
35, 38.)

Admitting, then, that, in several cases, these inju- Do. do.
ries of the spleen either arose, or were determined to itself es-
the concave surface, through the hard, distended, capes.
state (from presence of food) of the stomach, it is
cause of surprise that this distended stomach should,
in so many cases, have been able to determine, or
inflict, severe injury on the spleen, and yet, in every
instance but one, itself to escape all hurt. The causes
are, probably, those noted above—*viz.*:—the position Reasons
of the stomach; the mobility of its pyloric extremity, why
stomach
escapes.

which is very loosely attached to its surroundings ; and the fact that the spleen is, usually, soft, or friable, as well as enlarged, when it encroaches on the region normally occupied by the stomach when in a distended state with food.

The spleen, therefore, is the weaker vessel, and, as such, is, usually, the one to first suffer.

c.—Injuries of the intestines—complicating injuries of the spleen.

Proportion
of cases.

Of 37 cases of injury to spleen (omitting two gunshot cases) :—

in 11, there were other viscera injured;

in 1, only, of these, were the intestines the viscera to suffer.

It will be seen that, in the present cases, injury of the intestines was a very rare complication of injuries of the spleen.

In this
case,
rupture
was at
contact,
with
pointed end
of spleen.

In the only instance in which the intestines suffered, the spleen was firm in structure, and the rupture of the gut took place at the angle of junction of transverse with descending colon, just where the lower, pointed, end of the spleen was in contact with that region of the gut.

Contact of
colon and
spleen.

Quain (in his Anatomy) says, in speaking of the spleen :—

“The lower end is pointed, and is in contact with
“the left end of the arch of the colon, or with the
“transverse meso-colon.”

The details of the case are :—

Case No. 1, Kanda Thakor, ætat 23—Was beaten with the hands and fists ; he died, half an hour afterwards. *Post mortem* examination (on 18th November, 1877) showed spleen firm, but slightly enlarged : it had a rupture, $2\frac{1}{2}$ inches long, $\frac{3}{4}$ inch deep, across the concave surface, where it was in contact with a stomach, hard, and distended, with a recent full meal of rice. The stomach, itself, had suffered no injury. There was a rupture of colon at the angle of junction of transverse with descending portion, where the lower, pointed, end of spleen rested on it.

Case No. 1:
Details ;
violence by
hands,
rupture
of concave
surface of
spleen.

Colon rup-
tured
where
spleen
rested on it.

The man survived, for half an hour. The immediate cause of death was, evidently, the copious hæmorrhage from the wound of spleen, as nearly all the blood of the body was found, fluid, in the cavity of abdomen. There was no rib injured.

Death from
copious
bleeding
from spleen
wound.

What was the immediate cause of this rare injury? This rupture of the colon was, no doubt, the result of the shock of the severe collision between it and the lower, pointed, end of the firm spleen, where they lay in contact.

Rupture
of colon
was from
the colli-
sion with
spleen.

The almost normal size of the spleen accounts for its being in its normal relation to the colon, in this case ; while the firm condition of the spleen explains how it was capable of inflicting such an injury, and not, itself, suffering at the region of collision.

Spleen
in normal
relation to
colon.

If the colon were distended with faecal matter, or with flatus, at the time of the collision, this would,

perhaps, explain its liability to suffer such an injury.

Colon
perhaps
distended
with fæces.

It is not recorded that the colon was distended with fæcal matter; and any flatulent distention, which may have been present previous to, and facilitated the occurrence of, the rupture, would immediately disappear, on the gas escaping through the wound.

Influence,
on survival,
of the rup-
ture of
colon.

As regards the influence, on survival, of injuries of intestines, in cases of injury of the spleen, little can be deduced from the above case. The man died from the hæmorrhage arising from the wound of the spleen. In any case, it is probable that the influence of the intestinal wound would be exerted not so much to hasten rapid death, as to ensure an eventually fatal ending, in case the injured person tended to survive the spleen injury.

Case
No. 11:—
Gunshot
injury of
intestines,
spleen and
stomach;
survival
4 hours.

In a case of gunshot injury of the colon, and small intestines, as well as of spleen, and stomach, the injured person survived, for four hours. This was Case No. 11, Motia Cachari. The injury was caused by a bullet, out of a smooth-bore, piercing the abdomen from left to right, entering below left 11th rib, making its exit through the cartilage of the 9th right rib, near the sternum.

Reasons
why
intestines
escape:
their mobi-
lity,
elasticity,
loose

Causes explaining the immunity of the intestines from injury, in these cases of injury to spleen. In cases of shock, or violence, to the body, capable of inflicting injury on the spleen, and often on the

lungs also (in 9 cases out of 37), the reasons why ^{connec-} the intestines, ordinarily, escape (in 36 cases out of 37) ^{tions.} are, no doubt, their extreme mobility and elasticity; the looseness of their connections; and the fact that they are rarely tensely distended with hard contents (as the stomach periodically is).

The colon has not, however, the mobility of some ^{Colon is} other portions of the intestines. ^{more fixed.}

The transverse colon crosses the upper portion of ^{Its rela-} the abdomen; lying against the lower surface of the ^{tions, and} liver, the great curvature of the stomach, and, at its ^{connec-} left side, the lower, pointed end of the spleen. It is ^{tions.} bound to the back of the abdominal wall by the folds of peritoneum forming the meso-colon. At each side of the body, where it joins the ascending and the descending colon, it is more closely bound back ^{Angle of} than elsewhere. The descending colon, where it joins ^{junction of} the transverse, is closely bound back to the crus of ^{transverse} the diaphragm and to the left kidney; hence, at this ^{and des-} angle of junction of transverse with descending por- ^{cending} tion, the colon is, more or less, fixed and immobile; ^{colon} and, here, it is in contact with the lower, pointed ^{firmly} end of the spleen. (*Vide* Quain's Anatomy.) ^{fixed.}

Hence, this region of contact forms, always, a weak ^{And here} point for potential injury; and in the thirty-seven cases ^{it is in} of injury to the spleen (omitting two gunshot cases), ^{contact} in the only case in which the intestine also suffered, ^{with lower,} this point, which has been shown to be anatomically ^{pointed end} liable to injury, was the site of the rupture. ^{of spleen.}

Colon
liable to
flatulent
distention.

The colon, too, is more frequently met with, on dissection, in a state of tenseness, from flatulent distention, than any other portion of the intestine. From the fact of this angle of the colon being in contact with a firm, pointed, body, such as the lower end of the spleen, and being also closely fixed by its connections, if it be also tense from distention, it has a fair liability to become injured, in the violent shocks to the body which rupture the contiguous spleen.

It is, probably, only a healthy, firm, spleen that is capable of injuring the colon, by collision.

Spleen
large—is
below
colon.

When the spleen enlarges downwards, its lower, pointed, end soon passes below the angle of the colon ; while, from the softening accompanying these (malarial) enlargements, it ceases to have the firmness requisite to inflict injury on the intestine, but rather tends to, itself, suffer rupture.

When soft
itself rup-
tures.

(*d.*) *Injuries of the heart*—complicating injuries of the spleen.

Of 37 cases,

Of 37 cases of injury to the spleen (omitting two gunshot cases) :—

in 11, were other viscera injured ;

in 1, only, of these, did the heart suffer.

in 1, only,
did heart
suffer.

Injury to the heart, then, was very rarely found in cases in which the violence had been severe enough to cause injury to the spleen. In only one, among thirty-seven total cases, and in only this one case, among eleven of injuries of other viscera, was the heart injured.

The following are the details of this single case:— Details:

Case No. 14, Woochem Garo, ætat 30. Injured by Case No. 14.
a fall from a tree—survived, for five days.

Post mortem examination (on 1st January, 1875) Firm—
enlarged—
spleen
ruptured on
convex.
showed that the firm, though slightly enlarged, spleen
had a rupture 1 inch long, $\frac{1}{3}$ inch deep, on its
convex surface. This wound was blocked by a firm
semi-organised, clot. A few drops of blood were in
abdominal cavity, clotted, and adhering to the intes-
tines. No sign of peritonitis. Both lungs, intensely Both lungs
congested.
congested. *Heart* had deep-pink colored injection of
the endocardium—extending over the valves, and a Endocardi-
tis.
short distance into the aorta. Stomach empty, and
normal.

The heart suffered, in this case, apparently, from Heart
suffered by
the direct
shock.
the direct shock of the fall. That this shock must have
been severe, is shown by the fact that the spleen though Shock
severe.
firm, was ruptured on the surface which primarily re-
ceived the direct shock (convex—next to the abdomi-
nal walls); and by the fact that the lungs were so
injured as to be found extensively congested.

In the above case, the injury to the heart (together Main cause
of death—
the injury
to lungs
and
heart.
with that to the lungs) seemed the real cause of
death. For, during the five days of survival, the
danger from shock, hæmorrhage, and peritonitis—from
the rupture of the spleen—had passed; and dissection Spleen
wound was
in process
of recovery.
showed the wound of the spleen filled by a firm, semi-
organised, clot; while the few drops of blood, which
had been effused into the cavity of the abdomen, were

clotted, and becoming organised, among the intestines, without any signs of peritonitis.

Influence
of heart
complica-
tion on
period
of survival.

The fact that this man survived these injuries, for five days, demonstrates that, in these cases, injury—such as bruise—to the heart is not, necessarily, an immediately fatal complication ; though both the facts of this case, and physiological considerations, would lead us to infer that it is likely to cause the case to eventually terminate fatally.

(e.) *Injuries of the Liver*—complicating injuries of the spleen.

Liver in-
jured in no
case.

In thirty-seven cases of injury to the spleen (omitting two gunshot cases), in eleven there were injuries of other viscera also, but, in no case, did the liver suffer recognisable injury of any kind.

Chevers's
cases.

The writer notices that, in Norman Chevers's Manual of Medical Jurisprudence for India (3rd edition of 1870), are recorded only two cases in which spleen and liver were, both, ruptured ; while of ruptures of the spleen only, thirty-six cases are noted.

Thus, in thirty-eight cases mentioned by Professor Norman Chevers, in which the spleen was ruptured, in two cases, only, was the liver also injured.

Accord
with the
present
cases.

This, in the main, is in accordance with the experience of the cases of injury to spleen on which the present papers are founded, in thirty-seven of which (omitting two gunshot injuries), no injury to the liver was found, in any instance.

In one case, by gunshot, the liver was injured ; but this is of little interest in the present paper.

The details were :—

Case No. 12, Shookeny, ætat 35, woman. A bullet, Case of gunshot injury of the liver, spleen, and stomach. or slug, from a smooth-bore, entered the body between 7th and 8th right ribs, traversed the liver, from right to left, shattering to pieces the thin left lobe ; it cut a wound, through the stomach, three inches long, as if a piece had been gouged out ; pierced the spleen ; and, finally, passed out of the body, on the left side of abdomen, three inches lower down than the wound of entrance.

Whatever the degree of severity, or the nature of the violence, and whatever other viscera suffered in addition to the spleen, the liver invariably escaped, in the cases recorded in these papers.

In many cases of falls, the concussion, and crushing force, must have involved the right side, and the Right side often suffered. liver region.

In *Case No. 30*, from a fall, five ribs, on the right side, were broken, as well as all the ribs on the left side ; both lungs were pierced by broken ribs. The Case No. 30: 5 right ribs broken, right lung wounded, kidney ruptured, liver escaped. spleen was ruptured, by shock, from end to end of the convex surface—nearly split in half, in fact.

The right kidney was ruptured ; left kidney, contused. Here we have evidence of the severity of the concussion, and that the right side, and liver region, participated in the shock.

Yet the liver entirely escaped injury.

In five cases the right lung injured, in none the liver.

In five cases, the right lung suffered injury; in four of them, with the left lung; all from falls; in one case, it alone suffered, from blows with a bamboo stick.

In all these five cases, the concussion must have involved the right side, yet, in every case, the liver escaped injury.

Case No. 13: Fall, right lung bruised, liver escaped.

In Case No. 13, by a fall from a tree, both lungs were severely bruised, and of a bright scarlet color anteriorly. The healthy spleen had a rupture, 4 inches long, on convex. Liver escaped injury.

Case No. 14: Both lungs congested, liver escaped.

In Case No. 14, by a fall from a tree, both the right, and left, lungs were intensely congested. Endocardium pink, from injection; the firm spleen was ruptured on convex. The man lived, for five days. Liver escaped injury.

Case No. 17: Both lungs congested, spleen shattered, liver escaped.

In Case No. 17, by a fall from a tree, the right, and left, lungs were superficially congested; a large, soft, spleen was shattered (with 5 ruptures) against a distended stomach; three of these ruptures were on convex, one of them half through the spleen. There were severe bruises, and Colles's fracture of left wrist. Liver escaped injury. Dark serum was effused into each pleural cavity.

Case No. 31: Right lung congested. Effusion into both pleuræ, liver escaped.

In Case No. 31, from blows with a bamboo stick, the right lung was congested, and, in each pleura, was found about 8 ounces of bloody serum; the very large and soft spleen was ruptured. The liver escaped injury, though it was large, and soft. There were severe bruises among muscles, and tissues, of right

side, and corresponding ecchymoses on right costal pleura.

In all these five cases, the violence was severe ; the right side was involved ; the right lung, or pleura, suffered ; yet, in none, did the liver receive any injury.

In Case No. 38, the stomach suffered double rupture against a firm, healthy, spleen, which, itself, was bruised, on the surface of contact with the stomach. The liver was not injured.

Case No.
38 : Sto-
mach rup-
tured,
liver
escaped.

Many other, similar, instances might be quoted, but the writer has selected those, only, which show to what an extent the right side of the body, the chest, and its contents, may be injured, without the liver being, in any way, involved in the injury.

Reasons of immunity of Liver from Injury.

The reasons of the comparative immunity enjoyed by the liver, in these cases of injury to the spleen (and, often, to other viscera, also), are to be found in its situation, and surroundings, rather than in its structure, or in the nature and extent of the changes it undergoes, in ordinarily diseased states.

Liver's
immunity
—causes of.

The liver is a heavy (50 ounces, to 60 ounces, in the adult male) solid, body, compact, but not firm, easily lacerated. Quain (in his Anatomy) observes that it is frequently ruptured, during life, from accidents in which other parts of the body have escaped injury.

The liver
in health.

Structure
liable to
sustain
injury
easily.

As far as its structure is concerned, then, the liver is especially liable to sustain injury from the shock of external violence.

Its situation, surroundings, and modes of attachment, however, confer on it great security.

The Liver in health—its situation—surroundings—and attachments.

(a.) *Convex surface.*

Surround-
ings of
convex
surface of
liver.

The liver lies across the body; its upper surface is convex, and is accurately adapted to the shape of the diaphragm, against which it rests, and which divides it from the base of the right lung. The thin margin of the base of this right lung descends so as to intervene between the surface of the body and the solid mass of the liver, all round.

Elastic
buffer
formed by
the thin
margin of
base of
right lung.

The liver is protected, on the right side, by the six, or seven, lower ribs; and, in front, by the cartilages of the same, and the ensiform cartilage.—

Quain.

Other pro-
tections of
convex
surface.

The convex surface is thus thoroughly well protected by the elastic lung above, and by the mobile ribs and cartilages on the sides and front.

Ribs—
cartilages.

It enjoys further protection by the wonderful provision of nature, which has adapted the thin margin of the base of the right lung to descend between the solid mass of the liver and the surface of the body. This thin, intervening, edge of lung must act as an elastic buffer in softening and dispersing the concussions from external violence; and, in this

manner, admirably affords that protection which the liver, from its solid mass and friable structure, so much needs.

By this—convex—surface, the liver is suspended, Attachment of convex surface.
from the diaphragm, by the broad, or suspensory, ligament.

(b) *The concave surface.*

The under surface of the liver is concave, and Concave surface of liver.
is in contact with the stomach, colon, and kidneys.

The greater portion of this surface, except where Relations and attachments.
the large vessels enter, is free, and covered by peritoneum, and moves freely on the anterior surface of the stomach, the duodenum, and the colon.—*Quain.*

(c.) *The anterior margin* is thin, free, and the Anterior margin of liver.
most moveable portion of the gland.—*Quain.*

Thus, this portion, which by a little descent Free and moveable.
would have only the muscular plane of the abdominal walls in front of it, has the special protection of being most moveable, and capable of slipping aside from, or bending before, the shock of any concussion.

(d.) *The posterior border* of the liver is the Posterior border of liver.
most fixed portion of the gland, and is firmly bound, by areolar tissue, to the diaphragm.

(e.) *Of the extremities* of the liver, one—the Extremities of the liver.
right—is about three inches thick ; the other—the left—is very thin.

Both extremities are attached to the diaphragm, Attachments.
by peritoneal folds.—*Quain.*

General
mobility
and attach-
ments of
the liver.

The liver is thus seen to be suspended from the diaphragm, by folds of peritoneum ; it is free, and moveable, at its lower surface, and anterior margin ; only closely fixed, by areolar tissue, at its posterior border.

Resumé.

Resumé.—The liver, in health, is protected by its great mobility ; by the elasticity of the right lung above, and of the stomach (pyloric end) and colon below ; and by the elastic buffer of the lung margin intervening between its border and the surface of the body. Moreover, it enjoys the direct protection of lying behind the moveable lower ribs, the elastic cartilages of the ribs, and the ensiform body.

Protection
of the liver.

Base of
lung pro-
tects upper
part of
liver and
spleen.

With regard to the amount of protection afforded to the upper surface of the liver, by the elasticity of the base of the lung, it is interesting to note, for comparison, that in these 37 cases of injury to the spleen (omitting two cases by gunshot), by falls or blows, in no instance did even the spleen suffer injury to its upper surface where it is similarly protected by the elastic base of the contiguous lung, although every other margin, surface, and end, of the viscus suffered.

In 37 cases
of injury
to spleen,
upper end
never
suffered.

Liver,
weak in
structure,
great im-
munity
owing to its
surround-
ings, &c.

Thus, though the structure and mass of the liver causes its tissue to be facile of rupture, yet its surroundings and connections afford it such protection as to counterbalance the weakness of its structure, so effectually, that the liver, *in situ*, practi-

cally enjoys a marked immunity from injury, in cases where the body has met with external violence sufficient to cause injury to the spleen, and often to the lungs, or other viscera, also.

From the above notes, it would seem that the regions of the liver most likely to be injured are:—

Weak spots of the liver.

a.—The posterior portion, especially towards the right, where it is thickest and most firmly fixed.

Posterior and right region is fixed and in contact with hard bodies.

This portion of the liver, being fixed, and in contact with hard bodies (the vertebræ, from which it is only separated by the diaphragm and its right crus), is likely to be ruptured by direct, unbroken, shock, or to be crushed against the unyielding spine behind.

b.—The lower surface at its middle and left, where it is in contact with the bulging middle portion of the stomach. In the case of the stomach being distended, and hard, this thin portion of the liver might suffer rupture by being crushed against it—just as the spleen frequently is.

Lower surface at its middle and left.

As a matter of fact, these regions do seem most frequently to suffer.

Of three cases cited by Norman Chevers (*Manual of Medical Jurisprudence for India*, 3rd edition, 1870), in one, Nezoo, the under surface of the left lobe was ruptured in two places, the stomach being “full of an undigested meal;” in the second case (Ram L.), the stomach is not recorded as full; there were the following noted injuries:—

Cases quoted by N. Chevers.

Ruptures on these regions.

“A superficial rent on posterior, thick, margin

“of right lobe, and two others on the under surface.”

Liver in
disease.

Liver in disease.

From
malaria—
alterations.

From malarial poisoning, or fevers, the liver is rarely met with enlarged or softened to anything approaching the extent to which the spleen is so subject.

Cases—
Liver
softened.

In 39 cases in which the spleen was injured—in seven, the liver is recorded to have been large and soft ; in none of the cases was it injured, though, in two of them, the spleen was split almost in two.

Liver
rarely
descends
below the
ribs.

In the writer's experience in the malarial regions of Lower Assam, he has not, frequently, found the liver so enlarged—from malaria—as to descend much below the protection of the ribs and cartilages.

The organic structural changes which the liver undergoes, from chronic malarial poisoning, are not, ordinarily, such as to materially increase it in bulk, or in softness, or friability.

In the malarially diseased liver, there is a state of chronic congestion of the gland; but, from its structural peculiarities, although some increased formation of liver cells results in the lobules, this does not entail any extreme softening—these cells may rather add to the firmness of the gland. Nor does this increased cell formation go on sufficiently to increase the size of the liver very materially.

Malarial
liver,
characters
of.

The malarial liver is usually found slightly enlarged, firm, heavy, gorged with venous blood, of

dark purple color, or mottled with patches of dark pigment ; this deepened color, resulting, probably, from the presence of the pigment of hyperæmic exudations of blood which have taken place from the congested vessels.

Finally, then, chronic malarial changes do not, Resumé.
to any marked extent, entail alterations, in the liver Malarial changes in the liver do not
structure, of such a nature as to render it especially much
liable to suffer injury from external violence. increase its liability to injury. It
neither, to any extent, leaves the protection of its
normal site ; nor becomes structurally soft, or
friable, to any considerable degree.

In these respects, it is in marked contrast to the spleen when that viscus becomes affected by chronic malarial poisoning.

f.—The kidneys—injuries of—complicating in- Kidneys injured.
juries of the spleen.

In these 37 cases of injury to spleen (omitting Proportion of cases.
gunshot cases), in 11, other viscera also suffered ; in
one case only, did the kidneys so suffer.

In 38 cases of injury to spleen, cited by Norman Proportion in cases cited by N. Chevers.
Chevers (*Manual of Medical Jurisprudence in India*),
in only one case, is rupture of the kidney also,
recorded.

This injury may, therefore, be concluded to be Injury to kidneys rare.
rarely met with, in cases of injury to the spleen.

Among the present cases, the only instance of
its occurrence was in Case No. 30.

One case. *Case No. 30,—Kola Show, male, ætat 38, dissected on 6th May, 1871.*

By fall. The man died from injuries sustained by a fall from a tree.

All left ribs fractured. All the left ribs were fractured ; some, in two or three places. All were fractured through the shaft, and, some, at the angle, also. Two, or three, pierced the pleura, and wounded the left lung.

Five right ribs fractured. The right ribs, from the second to sixth, inclusive, were fractured at about two inches from their sternal ends—the second rib was fractured near its angle, also.

The cavities of both pleuræ contained effused blood.

Left lung pierced. The left lung was pierced in three places, and its surface covered with large, dark, clots. It was inflamed, and adherent, to the costal pleura, by recent bands of lymph.

Right lung pierced. The right lung was congested—it was pierced by the fourth right rib, the wound was closed

Clot in wound. Blood in pleura. by a clot of blood. This pleura contained about two ounces of blood. The spleen was ruptured, longitudinally, along convex surface, from the up-

Spleen ruptured. per, nearly to the lower end. This rent was deep, and gaped about two inches wide, at its upper end, but became more superficial towards its inferior end.

The abdominal cavity contained a large quantity of blood.

Kidneys. *Kidneys.—The right kidney was ruptured, trans-*

versely, near the hilus; about half an ounce of blood was effused into the areolar tissue, round it. The *left kidney* showed marks of contusion, in one or two places, but no blood was effused in its neighbourhood. This blood around the right kidney was behind the peritoneum, apart from the extensive effusion of blood, inside the peritoneum, from the ruptured spleen.

Right was ruptured at hilus, blood effused round it; left kidney bruised.

It will be noted that, in this case, the shock of the fall was very severe, as shown by the severity and extent of the injuries sustained.

Severity of shock.

It will be observed, too, that the whole of the left, and five of the right, ribs were fractured, many of them in more than one place. Both lungs were pierced by the ends of broken ribs. The spleen was split, longitudinally, nearly in two.

The violence, in this case, is shown, by its effects, to have been of exceptional severity, and it is scarcely cause for surprise that the kidneys participated in the injuries resulting from this severity, and the diffuse nature, of the shock.

It is astonishing that, in this case, the liver—which was large, and soft—should have escaped injury; yet so it did.

Liver escaped.

The kidneys, then, suffered in one case, merely, out of 37 cases of injury to the spleen (omitting gunshot cases); and, out of 11 instances in which other viscera (besides the spleen) suffered, in only one was this viscus the kidney.

Rarity of injury to kidney.

Reasons of
its immu-
nity.

The reasons, why the kidney enjoys this immunity from injury, seem to be the following:—

Size,
structure.

1. Its small size, and firm structure.

Embedded
in areolar
tissue and
fat.

2. Its being, usually, surrounded by much areolar tissue containing fat—in which it is, practically, embedded.

Protected
from injury
in front
and behind.

3. Its being entirely out of the way of injury from the front, as it has the whole of the contents of the abdomen anterior to it. Though the liver—ordinarily—and the spleen—when enlarged—rest against the kidneys, yet both liver and enlarged spleen are more likely to suffer injury than to inflict it, in case of their coming into sharp collision with the firm kidney.

4. Its being protected, from injury from behind, by the spine, and, by the thick, soft, pad formed by the muscles of the loin.

g.—Injuries to bones, and external tissues, complicating cases of injury to the spleen.

1. *To bones*—fractures, or dislocations.

Proportion
of bone
injuries to
cases.

Of 37 cases of injury to spleen (omitting two by gunshot), in 31 there were no injuries to bones ; in 6, there were fractures, or dislocations.

That is, in these cases of injury to spleen, about one case, in six, was accompanied by injuries to bones.

Mode of
causation.

In six cases of injury to bones, five were caused by *falls*, one was caused by a *blow* with a tiger's paw.

Of 19 cases of injury to spleen by *falls*, in five cases were bones injured; in three of these, ribs were fractured; in three, the forearm, at wrist, suffered—one case having both wrist and ribs injured.

By falls—
proportion
of cases.

Thus, in cases of injury to spleen by *falls*, there were injuries to bones also, in one case in three and-a-half nearly; the ribs suffered in, about, one case in six; the wrist, in one case in six, nearly.

In the five cases of injury to bones by *falls*—in all, the ribs, or bones of forearm, suffered; in one case, both.

By falls—
region.

Of 16 injuries to the spleen by *blows*—in one case, only, did bones suffer; in no case were the ribs, or bones of forearm, injured.

By blows—
proportion
of cases.

The case of injury to bones, by a blow, was the exceptional one of a stroke with a tiger's paw.

Ordinary blows, in no case, caused such injuries.

The above six injuries to bones were—in five, fractures—in one, dislocation.

Fracture—
dislocation.

The fractures were, of—

| | | |
|-------------------------------|-----|--------------|
| Neck | ... | ... 1 case |
| Ribs | ... | ... 3 cases. |
| Colles's fracture of wrist in | 2 | „ |

Regions of
fractures.

One case having both ribs and wrist fractured.

Fractures.

Case No. 22.—Together with injuries to body and spleen, the neck was broken, by a blow with a tiger's paw.

Case No.
22: Frac-
ture of
neck,

Case No. 9, *Hurmant Kolita*.—By a fall from a tree,

Case No. 9:
Five ribs

fractured
by fall.

there were five left ribs broken, from sixth to tenth, inclusive.

Spleen
pierced.

The jagged end of the eighth rib pierced the parietes, causing an external wound, 1 inch long, $\frac{1}{2}$ inch broad. The convex surface of spleen was torn, in every direction, by the ends of the fractured ribs. Death was almost immediate.

Case No.
30: All the
left and 5
right ribs
fractured,
both lungs
pierced.

Case No. 30, Kola Show.—By a fall from a tree, all the ribs on left side were broken, through their shafts, some in two or three places; five right ribs were also broken, near their sternal cartilages.

The left lung was pierced, in three places, and its surface covered with clots. The right lung was pierced by the broken end of the fourth rib, and, in this pleura, were two ounces of blood.

Kidney
ruptured.

The right kidney was ruptured at hilus, and half an ounce of blood was effused round it. Left kidney, bruised in places.

Case No.
21: Ribs
and arm.

Case No. 21, Dobagoo.—By a fall from a tree—the ribs, on left side, from second to sixth, inclusive, were broken, near their angles. The end of the third rib pierced the left pleura.

Colles's
fracture.
Left pleura
pierced.

There was Colles's fracture of the right forearm. There were three extensive ruptures of the spleen; one external, two internal. The man lived, for three hours, after the injury.

Case No.
17: Colles's
fracture,
both lungs
congested.

Case No. 17, Dorma Kolita.—From a fall; there was Colles's fracture of the left forearm. The large, soft, spleen, was shattered by five ruptures, three

on convex, two on concave surface. Stomach was full ; both lungs were congested, superficially. He survived, for half-an-hour.

In one case there was a dislocation.

Case No. 5, Adhur Rabha.—By a fall from a tree, the right wrist was dislocated. The large, soft, spleen was ruptured at its lower end. Death almost immediate.

Case No.
5 : Dislocation of
wrist.

Resumé.

In cases of injury to spleen by *falls*, or *blows*, there were injuries of bones in one case in six, roughly.

In 37 cases of injury to spleen by falls, or blows, and in six cases of injury to bones—in one, the neck was broken ; in three, the ribs suffered ; in three, the bones of forearm at the wrist. In one case, both rib, and wrist, suffered.

Of the three cases in which ribs were fractured—in two, the lungs, or pleuræ, were pierced by the broken ends ; in one case, the convex surface of the spleen was torn in every direction, and the parietes were pierced, by the broken ends of the ribs.

Resumé.
Proportion
of cases.
Regions.

Of the three cases of injury to the bones of the forearm—in two, there was Colles's fracture of the wrist ; in one, there was dislocation of wrist. In two, the right forearm suffered, *viz.*, one fracture, one dislocation. In one, the left forearm suffered fracture. In no case was there injury to bones of the lower limb.

Rationale of injuries of bones.

All, but
one, by
fall.
Rib or
wrist hurt.

It will be noticed that, with the exception of one case in which the neck was broken by blow from the paw of a tiger, all the cases of injury to bones were caused by falls, and were injuries of the ribs, or forearms (wrists).

Rationale
of wrists
suffering.

In severe falls, it is to be expected that the forearms, and ribs, should especially suffer. In a fall, the arms are, instinctively, thrown forward, either in hopes of clutching some support, or to break the fall; they, consequently, often strike the ground before the trunk does, and, so, receive the first brunt of the concussion.

Rationale
of ribs
suffering

In cases when the body falls from a height, and the trunk comes into violent collision with the ground, it is equally to be expected that the ribs should suffer fracture.

Frequency
of injury
to bones
by fall.
Rarity—
by blows.

It will be noted, also, that, in cases of injury to spleen by falls, injury to bones occurred in the proportion of one case in three and-a-half nearly; while, in injuries of the spleen by blows, in no case were bones injured—if we leave out the exceptional case of fracture of neck by blow from a tiger's paw. This illustrates the severer, and more diffuse, nature of the concussion from falls.

2. *Skin, subcutaneous tissues, and muscles.*

Only one
punctured
wound of
cavity.

Of 37 cases of injury to spleen (omitting two by gunshot) in one, only, was there a penetrating wound from the exterior into any cavity. In this

case, the parietes were pierced by the jagged end of a broken rib.

In the cases in which the body has met with violence sufficiently severe to cause injury of the spleen, the skin, and tissues, of the parietes, in the region on which the concussion impinged, ordinarily, show, on external inspection, or on dissection, marks of bruising or other injury.

Skin and tissues of region injured usually show marks.

This is, however, not invariably the case.

The most extensive injuries of internal organs may take place, without any mark being left on the skin, or any ecchymosis into it, or among the muscles beneath it.

Often no marks of bruise on, or in, skin.

It, not unfrequently, occurs, that, in injuries to the viscera, the skin and integuments, even in fair-skinned men, show no marks of injury or bruising, either on their surface, or in their tissues on dissection. This is, on rare occasions, also the case with muscles at the region where the violence impinged. More frequently, however, the muscles show distinct signs of ecchymosis, or even of rupture, whether the tegumentary coverings present marks of injury or not.

Occasionally so with the muscles.

It must be remembered, too, that the skin, in dark races, may show no visible, external, marks—no signs of discoloration—even when severe ecchymosis is found, in the skin tissues, on incision.

Dark skin may obscure bruise.

In persons of white, or brown, complexion, ecchymosis into the skin tissue is easily detectible by the discoloration on the surface of the skin.

On light skins bruises show.

Incisions
reveal
bruises
which did
not show
on the ex-
ternal skin.

In making *post mortem* examinations on the bodies of natives, in cases of suspicious death sent in by the police, it is a very useful practice, if the skin be very dark, to run a scalpel through the skin in every region of the body. This practice often reveals severe effusions of blood into the integuments, though the dark skin, over the patch of effusion, in no way differs, externally, from the skin where no such patches of effusion exist.

In falls.

Of 19 cases of injury to the spleen by *falls*—in several, the skin showed no marks, externally, on the surface struck.

Bruises
among
skin and
muscles
never
absent.

But, in no recorded case, was there an entire absence of ecchymosis in the tissues beneath the skin, or among the muscles.

In most of these cases, the bruises were about the various regions of the chest and abdomen, and were extensive, and severe.

From
blows
sometimes
no bruise
among
tissues.

Of 16 cases of injury to the spleen by *blows*—in several, there were no marks of bruising on the surface of the skin; nor were any found, either among the subcutaneous tissues, or in the muscles, on dissection.

a.—In cases caused by blows with the hand.

Rupture
by hand—
bruises in
the tissues,
none on
the skin
surface.

In two cases of rupture of spleen by blows with the hand—in one there were no marks of bruises on the surface of the skin, but extensive bruises in the skin and muscle-tissues, on dissection, over chest, and abdomen (Case No. 1).

b.—By bamboo blows.

In none, of six cases of injury to spleen by blows with a bamboo stick, or other such weapon, was there recorded absence of bruises among the tissues of skin, or in the muscles ; though, in some, no marks were visible, externally, on the skin surface.

Cases by blows with bamboo, bruises in tissues.

c.—By pounding.

In five cases of injury to the spleen by pounding with the knees, feet, &c., of assailants—in two, the spleen was *ruptured* ; in three, *bruised*.

Five cases by pounding.

In both the two cases of *rupture* of the spleen, by pounding, severe bruises were found among the tissues of the skin, and in the muscles of the body, as well as marks of discoloration externally, on skin surface.

In 2—rupture—bruises in tissues.

In one of these cases, the man had also been beaten by native shoes.

Of the three cases of *bruise* of the spleen, by pounding—one case survived, and was not examined about the time of the injury.

In 3, bruise to spleen.

The other two were under treatment, in hospital, immediately after the injury.

In none—bruise on skin.

Neither of them showed any sign of bruise discoloration on the skin surface, though careful search was made.

One case lived, and no dissection could be made into the tissues, to ascertain if ecchymosis did exist.

Case! No.
33: Pound-
ing—
spleen and
lung
bruised.
No bruise
on skin—
or among
tissues,

The other case—No. 33—died in hospital, and, on dissection, no sign of ecchymosis or injury was discovered in, or among, the integuments, or muscles, in any part of the body ; though the violence, which the man had been subjected to, must have been very severe ; for the spleen, though firm, had a bruise, on its outer surface 3 inch \times $1\frac{1}{2}$ inch, by $\frac{1}{3}$, to $\frac{1}{2}$, inch deep, and the left lung was severely congested, its anterior surface being, also, pink from ecchymosis.

d.—By other heavy blows.

Cases
Nos. 6 and
35.

In two other cases—Nos. 6, and 35—a single heavy blow was received on the region of the spleen, by which this viscus was, in both cases, badly shattered ; yet, in neither, did any sign of discoloration exist on the skin surface ; and dissection showed that, in both cases, the integuments, and muscles, in the region struck, were devoid of any sign of bruising.

Blow shat-
tering
spleen,
no bruise
in external
tissues.

Case
No. 6:
Spleen
ruptured
by blow, no
bruising on
skin, or in
tissues, on
dissection.

Case No. 6, Myadhur Kolutani, a woman, ætat 20,—was struck on the left side of abdomen with a heavy wooden-mallet, and died immediately.

On the fairly healthy spleen were found three ruptures, each from 2 inch, to 3 inch, long ; two, on the concave— one, on convex surface. The concave surface had come into collision with a stomach, hard, and distended with a mass of rice. There were no signs of bruises on the skin surface—nor in the skin tissues, or muscles, on dissection.

Case No. 35—Chunkea Sooba—was exercising on the parallel bars at the gymnasium, after a heavy meal; he slipped, and the left side violently struck one of the bars; the stomach was distended with rice, and the large spleen was shattered between it and the bar.

Case
No. 35:
Blow—
spleen
shattered.

The man was a fair-skinned Goorkha, and the region of body struck, was known, yet no sign of discoloration could be discovered on the skin surface; and, after death, dissection showed that neither the integuments, nor the muscles, had suffered any bruising, or injury.

Man fair
skinned,
No bruise
on skin, or
in its tis-
sues—or in
muscles.

Reasons why the skin often escapes injury while the deep tissues and organs suffer below it.

The peculiar distensibility, elasticity, and toughness, of the skin, are the causes which enable it, frequently, to escape injury when the internal viscera, or even strong bones, have been shattered by external violence.

Reasons of
escape of
skin from
injury.

The extreme mobility of the abdominal walls also assists in aiding the escape, in blows over the abdomen, of their muscles, which have not the special qualities of the skin to enable them to escape injury.

Elasticity
of the
skin—
mobility of
abdominal
walls.

In the cases of pounding by knees, feet, &c., in which no bruising of skin, or muscles, took place, probably the graduated mode of pressure, and the comparative softness of the parts used to inflict the crushing, enabled the external tissues to escape

Graduated
nature of
violence in
pounding
cases, and
soft organs
used to
inflict the
crushing.

injury. The fact of this method of assault causing much pain and injury, yet, ordinarily, leaving no certain external marks, has caused it to become a favourite mode of attack among the villagers. Such cases are, by no means, uncommon, but one rarely meets with them on the *post mortem* table, as fatal injuries are seldom inflicted.

Examples
—Power of
resisting
injury
possessed
by the
human
skin.

Instances of the wonderful power, of resisting injuries, possessed by the human tegumentary coverings, are to be found in Longmore's Treatise on *Gunshot Wounds*.

Case by
gunshot.

On page 97, of that work, he quotes a case in which, at the Alma, a European soldier was struck by a 24-pounder round-shot, which entered the abdomen in front, and ground the spine to pieces, without, however, injuring the skin of the back.

On page 98, of the same treatise, he cites a still more forcible example of the resisting power of the human skin:—

Case by
railway
train.

“In June, 1870, a railway train consisting of
“three carriages, a breakvan, and an engine
“weighing 32 tons, passed over the body of a
“young man while he was lying across one of the
“rails of the line of railway near the Euston Square
“station. On examination of the body afterwards,
“at University College Hospital, no wound was
“observed on the surface; but, on opening the
“abdomen, all the abdominal muscles were found
“completely cut through horizontally, and re-

“ tracted, leaving a gap from 5 inches to 6 inches
“ in width.

“ The muscles of the back were in the same con-
“ dition. The right kidney was cut in half. The
“ transverse colon, and a large portion of the
“ ileum, were cut away, detached, and lying free
“ in the abdomen. The body of the third lumbar
“ vertebra was crushed literally to powder. In
“ short, everything was divided except the skin;
“ the man was actually cut in half, but the conti-
“ nuity of the tegumentary covering prevented this
“ fact from being rendered obvious until the *post*
“ *mortem* inspection exposed it to view.*

* Vide *British Medical Journal* of August 20, 1870.

CHAPTER IX.

Head VII.—Can a spleen large at the time of rupture, contract and appear small on post mortem examination ?

Head VIII.—Seasons of the year at which injuries of the spleen are most common.

Head IX.—Spontaneous rupture of spleen.

Head VII.—The question may arise—Can a spleen, large at the time of injury, become, after rupture and effusion of blood, contracted and shrunk, so as, on the *post mortem* table, to mislead to the opinion that it was not abnormally large at the time of the accident ?

Medico-
legal im-
portance of
the ques-
tion.

This question is, from a medico-legal point of view, of the highest importance ; for, on the opinion of the medical witness as to whether the spleen was, or was not, abnormally enlarged at the time of the accident, hinges the inference as to the degree of violence necessary to have caused the rupture.

If a spleen, large and soft at the time of injury, can, by shrinking, simulate, on the *post mortem* table, a healthy condition of the viscus ; and if the

fact, that such post-rupture contraction might occur, were overlooked—the conclusion would be come to that nothing short of an extreme amount of violence could have caused the rupture ; and, hence, the case might bear a much more serious legal aspect than it, properly, should do.

This question, practically, must be answered in the negative, in the case of spleens suffering from chronic malarial enlargement ; though, in the case of a fairly healthy spleen temporarily distended during a fever period, such contraction might, to some extent, occur—though, probably, not to such an extent as to mislead on *post mortem* inspection.

The writer would beg leave to repeat what has been said, in a previous portion of these pages, concerning the elastic and muscular structure of the framework of the spleen.

The healthy spleen, its capsule proper, and the prolongations of this sent into the spleen-substance forming the trabeculæ, together with the sheathing canals, of the same tissue, in which are contained the chief vessels and their branches, are all highly elastic and endowed with a low amount of vital contractility, owing to their being largely composed of elastic tissue in which are found pale fibres of unstriped muscle.

It is owing to this peculiarity of structure that the spleen is capable of such great and sudden alterations in size.

In chronic enlargement—would not—

In temporary distention—may occur.

Recapitulation as to spleen framework.

Structure, elasticity, contractility of spleen framework.

Spleen
vessels and
pulp.

Besides this framework, the spleen consists of bloodvessels, and a spleen tissue proper.

The vessels of the spleen are extremely numerous and capacious.

Large
vessels lie
in the con-
tractile
sheathing
canals.

The larger bloodvessels and their main branches lie in, and are enclosed by, sheathing canals formed by prolongations of the elastic, contractile, capsule tissue.

Thus, these large arteries which have little or no contractile power—from more or less complete absence of the middle muscular coat proper to arteries—lie in contractile sheaths of spleen tissue.

Small
arteries lie
free on the
trabeculæ.

The smaller arteries, which possess the middle muscular coat in a well developed condition, and are, in themselves, highly contractile, lie free on the trabeculæ, and terminate in numerous capillary tufts, which, in close relation with large venous plexuses lie, supported by the trabeculæ, in the spleen pulp.

Capillary
tufts and
plexuses.

Spleen
pulp,
structure
of—

The spleen pulp.—The spleen-substance proper consists of a soft, pulpy, matter, resembling grumous blood. It has no definite, permanent, structure (such as the liver stroma), but consists of cells, nuclei, and granular matter ; a mass of debris—so to speak—of blood cells in every stage of the processes of disintegration and formation ; shifting, and varying in amount, according as the blood-supply varies in quantity or materials.

Unstable
nature
of—

Power to
undergo

Thus, in the structure of the spleen we have

every condition capable of adapting this viscus to changes in size. undergo those rapid and great changes in bulk, which are so remarkable a characteristic of it.

The capsule, trabeculæ, and the sheathing canals Frame-work, elastic and contractile. for the large bloodvessels, are all formed of a highly elastic tissue capable of great distention, and of exercising some contractile power.

The large arteries—themselves scarcely contrac- Vessels—contractile arrangements of— tile—from their middle muscular coat being almost wanting—are enclosed in these contractile sheaths; the smaller arteries—in themselves contractile—from the thickness of their muscular coat—lie free.

The muscular fibres of the whole of this system Innervation. are of the same—unstriped—variety, and are governed by the same—sympathetic—system of nerves.

Hence, they may all contract, or relax, in unison, on the application, or withdrawal, of the same stimulus.

During a general contraction of the muscular Rationale of rapid changes in size of spleen. fibres of this system, the sheathing canals would compress the large arteries and diminish their calibre, and, consequently, lessen the amount of blood Action of the musculo-vascular system. entering the spleen; the small arteries, themselves, directly contract; the capsule and trabeculæ, also contracting, would diminish the calibre of the veins and capillaries, and express the blood from the spleen; which viscus is, in this manner, capable of undergoing rapid diminution of size.

The shifting, variable, nature of the spleen pulp Influence of the true

spleen
pulp.

also assists in these alterations of the spleen in bulk; as it, no doubt, constantly varies in amount according to the blood-supply—increasing with increased supply—diminishing with diminished supply. The quality of the blood, too, influences the spleen pulp—for example, the blood rich in formative materials, during digestion, has the effect of rapidly increasing the amount of spleen pulp, for the time.

Distention
of spleen.

Conversely, the withdrawal, or inhibition, of the influence of the sympathetic nerves would cause a general relaxation to take place, and, acting simultaneously through the whole muscular system of the spleen structure, would induce a general laxness, and capacity of being largely distended by the pressure of the blood circulation, on account of withdrawal of the normal, tonic, contraction of the muscular fibres of the spleen framework and vessels.

Frame-
work of
spleen a
constant
quantity.

From what has already been premised as to the structure of the spleen, it seems that the framework of the viscus may be considered as a more or less constant quantity; not undergoing changes in bulk of a sufficiently marked nature to be a material factor in the changes in bulk of the spleen in malarial enlargements of that viscus.

Variations
in bulk are
of the
bloodves-
sels and
spleen
pulp.

Variations in the bulk of the spleen must, then, depend on variations in the conditions of one, or both, of the other two component parts, the blood-

vessels, and the spleen pulp. As a matter of fact, it depends on both.

The healthy spleen may undergo rapid distention during a paroxysm of fever, or during digestion, and, on the conclusion of these conditions, may, as rapidly, return to its normal size.

Temporary distentions of spleen.

Such distention is due, partly, to dilatation of the small arteries, and, consequently, of the capillary tufts and venous plexuses—relaxation of the muscular tissue of the whole system of spleen framework, sheathing canals, and bloodvessels, taking place simultaneously; it is partly, also, due to an increase in the amount of the spleen tissue proper.

Rationale of—

During the period of distention, such a spleen might suffer rupture on the application of an amount of violence incapable of injuring it in its ordinary and normal state.

Rupture during temporary distention.

Were such a spleen ruptured during such a period of temporary distention, much blood would be lost; the previously abnormal tension of the bloodvessels would cease; they would become reduced in calibre; and the amount of blood in the spleen would be materially diminished.

Results of such rupture.

This would be especially so when, as frequently occurs after rupture of spleen, nearly all the blood has been withdrawn from the circulation, by profuse hæmorrhage into the cavity of the abdomen.

Loss of blood.

The amount of true spleen pulp would, however, Spleen pulp

would remain. remain the same, and not be diminished by the accident.

The healthy framework—retaining elasticity and contractility—would contract uniformly. The elastic framework of this spleen (capsule and trabeculæ), not having suffered deterioration by chronic disease, and still retaining its elasticity and contractility, would, from the re-action of elastic distention, and by action of its contractile power, be capable of availing itself of the loss of some of its blood contents to recover itself from the previous state of abnormal distention, and to contract, in size, to a degree proportionate to the reduction in the calibre of its vessels and the diminution of their fluid contents.

Nature of such contraction, appearances of such a ruptured spleen— Such contraction would be more or less uniform, and would leave the spleen smaller in size than it was before rupture; and though, probably, somewhat soft in consistence, yet full, and even, in appearance; unlike the flabby, limp, appearance presented by the permanently enlarged malarial spleen, when ruptured, and deprived of some of its blood contents; for this latter spleen has, by disease, lost its contractility, and is, no longer, capable of exerting any definite amount of contraction, on loss of some of its contents; it, therefore, still looks large—but collapsed, shrivelled, puckered, and empty.

Amount of spleen pulp remains. Partial diminution in size. As, however, after rupture of the temporarily-distended healthy viscus, the amount of spleen pulp, increased during the temporary distention, remains

after subsidence of the vascular engorgement, this limits the contraction of the viscus, so that it still appears enlarged, and, probably, soft, from retention of this increase in the spleen pulp proper.

There is little doubt that every period of dilatation of the splenic capillary and venous plexuses is accompanied by an increased amount of spleen pulp; this is certainly the case in the temporary distention during digestion. The spleen cannot be looked on as merely an erectile body, whose increase or decrease in size depends merely on the amount of blood present—its vascular turgescence, indeed.

It is an erectile body, in structure, and behaviour; but it is something more; for the presence of the spleen-substance proper—pulp—endows the viscus with special functions, and with special peculiarities and capabilities.

Thus, after rupture of any enlarged, or distended, spleen, the increased amount of spleen-substance proper—pulp—would remain, *in situ*, after the injury, and prevent the ruptured viscus resuming a normal size or appearance.

Finally, though a fairly healthy spleen, ruptured during a period of temporary distention, might, after rupture and loss of blood, contract, uniformly, in size, to some extent, it could not do so to an extent sufficient to, in any way, enable it to resume its normal size, or simulate its normal appearance; or to mislead, at the period of dissection, as to the

Hyperæmia of spleen accompanied by increase in spleen pulp.

Spleen an erectile organ, but something more.

Increased spleen pulp remains after rupture.

Conclusion with regard to rupture of temporarily distended spleen.

condition it had been in at the time the rupture occurred.

Permanently Enlarged Spleen.

We next come to the consideration of the same question with regard to the permanently enlarged spleen.

Chronic
malarial
enlarge-
ment,
increase in
pulp.

In the permanent enlargement of the spleen due to the slow, long-continued, action of the malarial poison, or to repeated attacks of malarial fevers, the increase of the viscus in bulk is, no doubt, chiefly due to an increase in the amount of spleen-substance proper—pulp.

Distention
of small
blood-
vessels.

There is little doubt that the capillary tufts and venous plexuses are permanently increased in size, if not in number, though not, probably, in proportion to the increase in the amount of spleen pulp. This general distention of the small bloodvessels practically constitutes a form of congestion, or low inflammation, and new products from this inflammatory action are, probably, exuded, and mix with the spleen pulp.

Exudative
products.

Frame-
work loses
—elasticity
—and con-
tractility.

From these changes, of a chronic inflammatory character, which cause the malarial enlargement, the capsule and trabeculæ become altered in structure, the white fibrous tissue relatively increases in amount, and the elasticity and contractility of the tissue are diminished, or lost.

Rationale
of the
softness
of mala-

The softness, and facility of rupture, of such an enlarged spleen, are due to the excessive and dispro-

portionate increase which has taken place in the ^{rially enlarged} amount of its spleen pulp, relatively to the bulk of ^{spleen.} the supporting framework of trabeculæ; and, probably, to the presence of congestive, or inflammatory, exudations.

When congestive exudations, of a fluid character, ^{Typical soft, malarial spleen.} have taken place, from the distended vessels, into the spleen pulp, the abnormal softness of the malarially enlarged viscus is still further increased.

This state constitutes the typical conditions of the *soft, malarial spleen*.

When this condition attains a climax, the spleen ^{Dropsy of spleen.} is met with resembling a mere bag of blood—this state might, probably, be aptly defined as one of dropsy of the spleen.

The hard, but friable, condition of certain spleens, ^{Rationale of the friable enlarged spleen.} permanently enlarged from chronic malarial poisoning, seems due to an excessive amount of exudation of semi-organisable lymph, having sufficient cohesion to feebly coagulate among the spleen pulp, and form, with it, a caked mass, somewhat hard, but easily broken down.

These are the two conditions of enlarged spleen almost invariably met with in the cases of rupture of the viscus so frequent in India.

The writer does not think that, in malarial enlargements of the spleen, a hard and tough condition of the viscus—from extreme increase in the true fibrous tissue of the trabeculæ and sheathing canals ^{Tough condition from hypertrophy of framework—rare in}

malari-
ally
enlarged
spleens. for the large vessels—is often, if ever, met with ; though both these trabeculæ and the capsule are, commonly, more or less thickened from deposition of effused, organisable, lymph.

Rupture of
the perma-
nently
enlarged
malarial
spleen. As this chronic enlargement of the spleen does not depend, to any great extent, on temporary dilatation of its vessels, but on true increase in the elements of its structure ; when such a spleen is ruptured, there may be, and usually is, great effusion of blood ;

Changes
resulting. but, as there was no state of great previous distention of the bloodvessels, there does not result much consequent decrease in their calibre ; the amount of

Pulp
remains *in*
situ. spleen pulp and of exudative matters remains the same ; consequently, much decrease in bulk cannot occur. Moreover, owing to the loss of elasticity and

From loss
of elasticity
and con-
tractility,
cannot
contract. contractility of the capsule and trabeculæ, the permanently enlarged malarial spleen can neither exert much elastic resilience, nor undergo any uniform contraction, even after the loss of much of its blood-contents.

Appear-
ances after
rupture. It does not decrease, uniformly, in size. We, practically, find the permanently enlarged malarial spleen, after rupture, of the same dimensions as before, but looking wizened, crumpled, flabby, and less full than the similarly enlarged malarial viscus in its non-ruptured state.

Weight of
such
spleens
after
rupture. The amount of matter which still remains in such a spleen (after it has been ruptured, and, together with the rest of the body, drained of blood,

by profuse hæmorrhage into the abdominal cavity,) is shown by the weight such ruptured spleens are found to have on *post mortem* examination.

In one of the writer's cases (No. 24) it weighed ^{In one case} 44 oz., after all the adhering blood had been washed out of it. _{44 oz.}

In another case (No. 27) it, similarly, weighed, ^{28 oz. in} after rupture and profuse bleeding, 28 oz., in a boy _{a boy.} of 15 years of age.

In a third case (No. 18) it weighed, under similar conditions, 28 oz., in a child of 12 years of age. ^{28 oz. in} _{a child.}

In a fourth case (No. 23) it weighed 30 oz., ^{One case} after being washed. _{30 oz.}

In all these four cases, nearly all the blood of the body was found effused into the cavity of the abdomen.

So that, though these spleens must have been well drained of blood, they still retained great weight, and were, after rupture, practically not diminished in measurements, though looking wizened, puckered, and less full.

Resumé.—To summarise, in a few words :—

Resumé.

A fairly healthy spleen, ruptured during *temporary enlargement*, might undergo a certain amount of uniform contraction, and become evenly reduced in size, though not to an extent likely to mislead. ^{Final} _{summary.}

A spleen in a state of *permanent* (chronic) *malarial enlargement* does not, after rupture, undergo uniform contraction, but retains its dimensions,

though it usually looks collapsed, limp, crumpled, and wanting in fulness.

Head VIII.—Period of the year at which injuries of the spleen are of most frequent occurrence.

Cases cited
by Norman
Chevers.
Seasons of
occurrence.

In Norman Chevers's *Manual of Medical Jurisprudence for India* (3rd edn. of 1870, p. 458)

Mr. Heddle notes that the four cases he reports all occurred at the season of termination of the monsoon, the period at which intermittent fevers, and, consequently, splenic enlargements, are most common in Bombay, where, the cases noted, occurred.

Seasons of
36 present
cases.

The writer has tabulated, according to season of occurrence, 36 of the 39 cases of injury to the spleen on which these papers are founded.

Cases
omitted.

Two gunshot cases, and one caused by a tiger, are omitted, as having no practical bearing on this point.

Of the remaining 36 cases—

Cases—
spleen
healthy :—

In seven, the spleen was more or less healthy.

The injuries to these occurred—

Seasons.

One case, in January
One ditto, in February
One ditto, in August } Injury caused by *fall*.

By fall.

By blows.

One ditto, in February
One ditto, in March
One ditto, in October
One ditto, in November } „ „ by *blows*.

Cases of
healthy
spleen
season of
no effect.

The above seven cases are classed apart, as, in them, the spleen was but little, or not at all, diseased; they are, therefore, less pertinent, than those that follow, to the consideration of the season

at which malarial enlargements of the spleen render that viscus especially liable to injury.

Of the remaining 29 cases—in 25, the injured spleen was large and soft, often extremely so, from malarial causes; in four, its exact condition is not recorded.

Other cases spleen diseased.

In these 29 cases, the injury occurred as follows:—

TABLE IX.

Analysis of 29 Cases of Injury of Diseased Spleen—with regard to the Season of Occurrence.

| Months. | By Falls. | By Blows. | By Fall, or Blow. | Total. |
|--------------------|-----------|-----------|-------------------------|--------|
| January | 2 | 1 | 1 | 4 |
| February | 2 | ... | ... | 2 |
| March | ... | 1 | ... | 1 |
| April | ... | 1 | ... | 1 |
| May | 1 | 2 | ... | 3 |
| June | 6 | 1 | ... | 7 |
| July | 1 | 2 | ... | 3 |
| August | ... | 1 | ... | 1 |
| September | 1 | ... | ... | 2 |
| October | 1 | ... | ... | 1 |
| November | 2 | 1 | ... | 3 |
| December | 1 | 1 | ... | 1 |
| | 17 | 11 | 1 | 29 |

Deductions
January
and
June have
excess of
cases.

From this Table IX, it will be gathered that the cases of injury to malarially enlarged spleens, in this District (Kamrup) of Assam, occurred with some approach to equal frequency in each of the months through the whole year, except that January, and, especially, June, show an excessive number of cases.

Excess in
June, all by
falls.

In analysing the Table, according to the mode of violence causing the injury, we find that the great excess of cases in June was entirely due to those caused by falls from trees; and that, with this exception, cases caused by falls were as frequent (more so, indeed) in the cold season, as during either the hot, or, the autumn, months.

Otherwise
cases same
in all
months.

Cases by
blows.

The cases caused by blows were distributed pretty evenly through the year.

Fever
season
in Lower
Assam.

In this intensely malarial district, Kamrup, Lower Assam, the period of greatest prevalence of intermittent fevers is during July, August, and September.

Seasons
of this
region.

The early rains begin late March, or early in April, and last, ordinarily, till the middle of June. During the latter portion of June, and in July, there intervene a few weeks of dry, hot, weather between the early, and the later true rainy season.

Early, and
later
rains.

August and September are characterised by very heavy rainfall and great heat.

In October, cool weather begins to set in, which lasts, usually, well into March.

This portion of Lower Assam is characterised as Elements of malaria. possessing all the factors of malaria in a typically concentrated form.

Hence, intermittent fevers prevail, extensively, Intermittent fevers universal. at all seasons.

The malarial poison has sufficient activity and Enlargements of spleen—through whole year. intensity to maintain the spleens of the inhabitants, almost universally, at a more or less high standard of enlargement, softness or friability, and facility of rupture, all through the year.

There is, thus, scarcely any scope left for increase in the prevalence of enlarged spleens during the autumn months.

Consequently, the spleen is almost universally Hence—injuries of spleen through the entire year. in a more or less swollen, fragile, condition, rendering it extremely liable to suffer injury nearly equally at all the seasons of the year; and *Table IX* shows that, as a matter of observed fact, it does so suffer it.

The writer thinks that the excessive relative prevalence of cases of injury to this viscus, by falls, Excess of cases—by falls—in June. Explanation. during June, is partly due to the fact of that period being the height of the fruit season, when more persons ascend trees, and, hence, more fall out of them.

Injuries to the spleen, by blows, show no increase in frequency during the month of June.

The great prevalence of malarial affections, and Prevalence of malarial affections. of splenic enlargements, in this district, ceases to

be surprising when the physical characters and climate of the region are considered.

Physical
charac-
ters—
marshes;
jungle.

A large portion of the area of the district consists of marshes, (vastly extending in the rains—seething into partial dryness under the dry season's sun), and of jungle, chiefly grass—often 20, to 25, feet high.

Climate.

These conditions of soil, added to the influence of an atmosphere hot, and, uniformly, almost saturated with aqueous vapour, have contributed to

Reputation
as malari-
ous re-
gions—

earn for these regions a well-earned reputation for being intensely malarious and fever-stricken; as well as an equally well-deserved reputation of being one of the best regions in India for shooting large game.

Field for
study of
malarial
affections.

To the physician, this region affords an almost unrivalled field for the study of injuries, and malarial affections, of the spleen.

Field for
large-game
shooting.

To the sportsman, it offers the excitement of meeting the wild elephant, the rhinoceros, the buffalo, bison, and tiger, in their natural habitat.

Head IX.—Spontaneous Rupture of the Spleen.

Applica-
tion of the
term.

The term spontaneous rupture has been applied to cases in which the spleen has been ruptured without the application of any external violence to the body.

Does truly
spontane-
ous rupture
occur?

That the spleen ever enlarges, or becomes gorged and distended, to such an extent as to rupture of

itself, in a manner truly spontaneous, the writer does find difficult of credence.

It seems probable that, in exceptional cases, the temporarily distended, or the permanently enlarged and disorganised, spleen may be ruptured by muscular action of the abdominal walls, and the consequent compression of the spleen against some resisting internal body, such as the spine, left kidney, or the stomach when in a state of distention. Such ruptures cannot be accurately defined as spontaneous, though all the recorded cases, so termed, seem to have been caused in the manner above described—by muscular action.

Rupture of the distended spleen by muscular action of the abdominal walls.

Chronic malarial enlargement of the spleen usually comes on slowly and is accompanied by the condition of body known as the malarial cachexia. In this anæmic condition of the system there is loss of muscular power, and a wasted state of the muscles.

Muscular atrophy from malarial cachexia.

The plane of muscles forming the abdominal wall markedly participates in this wasted condition. In this state, the abdominal muscles are incapable of the powerful, sudden, contractions which would so imperil the enlarged and easily rupturable spleen. This enfeebled condition of the muscles, hence, becomes a source of protection to the fragile, swollen, spleen, and removes a source of danger.

Abdominal muscles, atrophied—incapable of powerful contractions.

The writer has met with several cases in which the spleen was enlarged to such an extent as to occupy the whole abdominal cavity, and simulate

Enlarged spleen may occupy whole abdomen.

the external appearance of a pregnancy at full period. These spleens were very soft, and, apparently, ready to rupture on the occurrence of the slightest violence or compression to them. All these cases were accompanied by intense malarial cachexia, and a thin, wasted, condition of the muscular system. In one of the cases, the plane of the abdominal walls was so thin that the muscular tissue seemed to have almost entirely disappeared. The thin layer of skin, devoid of adipose tissue, seemed the only covering over the enormous mass of the spleen, which, when not supported by the broad, stout, kummerbund which the man habitually wore, became pendulous, and tended to seek the support of the thigh.

Soft—and
readily
rupturable.

Atrophy of
abdominal
muscles—
with this
condition
of spleen.

In this case, the atrophied abdominal muscles were manifestly incapable of exerting any contraction sufficiently powerful to imperil the integrity of the spleen.

This
atrophy
removes a
source of
danger.

Had such an enormous, and fragile, spleen been covered by powerful, well developed, abdominal muscles, it could scarcely have escaped being crushed against the spine, or kidney, or the stomach during a period of distention of that viscus.

The fortunate, protective, coincidence of wasted, and enfeebled, abdominal muscles with greatly enlarged spleens, forcibly struck the writer in several of the above cited instances.

In a system unbroken by cachexia, and in full muscular vigour, if the spleen become gorged into extreme distention during a fever paroxysm, probably rupture might occur by the compression exerted on the distended spleen by violent action of the powerful abdominal muscles.

Rationale
of rupture
of spleen
by muscular
action.

Of such a nature, seems to be the case quoted by Norman Chevers (*Manual of Medical Jurisprudence in India*, p. 460, edition of 1870).

Cases of
spontaneous
rupture.

In this case, the Danish sailor is described as of “herculean build, and lofty stature,—I think, “the strongest built man of his age I have ever seen. “—and he was very ill with the severe intermittent fever of that locality, one of the peculiar effects of which is to bring the lower end “of the spleen, to about the size of a goose-egg, “down below the left ribs, after three or four “paroxysms.”

Case by N.
Chevers :

In this case we have the conditions most favourable to rupture of the spleen by muscular action, viz., a frame of herculean muscular force, unbroken by any cachexia, associated with a rapidly induced distention of the spleen.

Conditions
for rupture
by muscular
action.

Another case* is reported by Dr. A. Porter, of Akola, in which it seems probable that a softened spleen was ruptured, to the extent of half an inch,

Cases of
rupture of
soft spleen
by spasm
of muscles.

* Madras Quarterly Journal of M. S., October 1866, p 403.

near hilus, by a tetanic spasm of the diaphragm and abdominal muscles.

Rupture of
the liver
by muscular
action
and by
shock.

Cases of *rupture of the liver* are recorded by Dr. Taylor, caused by sudden, violent, muscular effort to avert a fall from horseback ; and by the shock of falling on the feet from a considerable height. (*Manual of Medical Jurisprudence in India*, p. 460, edition of 1870.)

Case No. 35 : The
final rupture
of the capsule
—by muscular
action.

The writer has seen no case of truly spontaneous rupture of the spleen, or of rupture by muscular action, but his case No. 35, Chunkea Sooba, seems to have been, in point of fact, at the final bursting of the spleen capsule, a case of rupture by muscular action.

Details—
Stomach
distended.

In this case, the man had a soft, enlarged, spleen. He was exercising on the parallel bars at the gymnasium immediately after a heavy meal, the stomach being distended and hard with the mass of rice contained in it. By a slip of the hands, the left side, at the region of the spleen, was brought into violent collision with the left bar, and the soft spleen was crushed between the bar, on the outside, and the distended, unyielding, stomach, on the inner side. After the accident, he walked about 150 yards, to the Hospital, and showed no signs of collapse or prostration. He survived for four days. During these days, the most marked symptoms

Power of
exertion
after the
accident.

Symptoms: were:— a permanent rise of two degrees in temperature, and severe pain, limited to the region of the spleen, and increased by pressure or motion.

There were no signs of blood-loss, nor any symptoms of peritonitis. No general tenderness, or tumefaction, of the abdomen.

No signs
of blood-
loss or
peritonitis.

The spleen could be felt as a large globular mass reaching nearly as low as the umbilicus.

Spleen—
felt.

He was a young man of fine, athletic, build, and powerful muscular development, and was, in no way, cachectic.

Athletic—
powerful
man.

On the fourth day after the accident, he suddenly fell back dead, while raising himself in bed.

Died on
fourth day.

Post mortem examination showed that the capsule of the spleen was distended into a globular shape, by internal hæmorrhage. The capsule was distended with a firm clot of blood, which quite filled it, and fitted into the ruptures which had taken place in the true spleen tissue. The spleen tissue had been compressed by this clot, it was pale, and contrasted strongly with the dark color of the firm clot. This mass of clot had, evidently, formed in situ, and was some days old.

*Post
mortem*
appear-
ances.

Capsule.

Mass of
firm clot—
inside
capsule.

Remains of
spleen
tissue.

The capsule was enormously thick, and resembled chamois leather. In places, it had become discolored and softened, and, in these regions, were several ruptures extending through it and deeply into the firm enclosed clot-mass, which was, itself, fissured in these several places. No blood was found in the abdominal cavity, except one square, ragged, fragment of the firm clot inside spleen capsule. This was lying just outside the largest

Capsule—
thickening
of:

discolored
and soften-
ed in
patches.

Ruptures
through

contained rupture of the capsule and clot-mass, and had, evidently, been broken, in a solid state, off the clot-mass, and had not formed where it was found.

fragment
of clot.

The largest rupture through the clot and capsule was where the globular spleen-mass lay against the spine.

Rationale
of the
injury.

Rupture of
spleen
tissue.

Capsule
remained
intact.

Blood
effused into
capsule;
coagulated
there.

Softening
of capsule.

Compres-
sion against
spine—
rupture of
softened
capsule and
contained
clot-mass.

In this case there seems little doubt that the spleen tissue had been ruptured inside the enormously thick capsule—which had remained entire—at the time of the primary injury on the gymnasium. Bleeding seems to have gone on into the capsule, distending it into the globular shape found on dissection, and quite filling the capsule with the firm clot coagulated inside it. No blood had escaped into the abdominal cavity. The limit of distention of the capsule being reached, bleeding was arrested. Hence the absence of symptoms of blood-loss, or of peritonitis.

The man was of robust and powerful muscular development; and, eventually, the sudden and powerful effort of contraction of the abdominal muscles, on the man's raising himself in bed, seems to have compressed the globular and swollen spleen-mass, against the hard spine, with a degree of force which the disorganised capsule was, at this time, unable to bear, and to have, consequently, caused this capsule to give way in the regions of several of the softened patches.

The eventual rupturing of the capsule and of its firm clot-contents seems, in this case, to have arisen entirely from powerful muscular action, and the case may fairly be classed, in this respect, among the recorded instances of rupture by muscular action—sometimes miscalled spontaneous rupture.

Case is one of rupture by muscular action.

CHAPTER X.

ABSTRACT OF THIRTY-NINE CASES OF INJURY TO THE SPLEEN.

Case No. 1.—Kanda Thakor, male, ætat 23, dissected on 18th November, 1877.

Blows,
with
hands, feet,
&c. Nature of violence:—Sharp blows with hands and feet of assailants.

Bruise on skin, none.

External
effusion. Great effusion into tissues of integuments and muscles of both sides of abdomen, and over the lower ribs.

Rupture
of colon. Rupture of colon, at angle of junction of transverse with descending portions. No ribs broken. No lung injury.

Spleen
firm,
ruptured
on concave. The somewhat enlarged, but firm, spleen had a rupture in the direction of the narrow diameter of the concave surface, about two-half inches long, and three quarters of an inch deep.

Blood in
abdomen. Nearly all the blood of the body was found fluid, among the intestines, in the cavity of the abdomen.

The stomach was distended with rice.

Period of survival:—half an hour.

Case No. 2.—Kalamoni, woman, ætat 50, dissected on 28th January, 1877.

Nature of violence:—Blows with a heavy bamboo stick. Blow with bamboo.

Bruises on skin, no marks of.

Effusion into tissues:—Much blood effused into teguments and muscles of left side. External effusions.

Spleen, enlarged and soft, had a rupture on its concave surface, extending from the hilus to upper border. Spleen ruptured on concave.

The abdominal cavity contained a considerable quantity of partially coagulated blood. Blood in abdomen.

Period of survival:—five hours.

Injuries to other viscera, none.

Lived—five hours.

Case No. 3.—Runganath Surma, male, ætat 31, dissected on 12th November, 1876.

Nature of violence:—Fall from a tree.

Fall.

There was a single rupture of the enlarged, soft, spleen. Spleen, soft, ruptured.

Period of survival:—two and-a-half days.

Lived for 2½ days.

Case No. 4.—Dome Kos, male, ætat 36, dissected on 2nd November, 1876.

Nature of injury:—Blows with the hand, received in a quarrel. Blows with hand.

Marks of bruises visible on back, between the shoulders. External bruises.

Spleen
front edge
ruptured.

Spleen, greatly enlarged, had a long rupture at front edge.

The abdominal cavity was full of blood.

The whole body was exsanguine. Heart and lungs, bloodless.

Death immediate.

Case No. 5.—Adhur Rabha, male, ætat 12, dissected on 18th October, 1876.

Fall.

Nature of violence:—Fall from a tree.

External
bruises.

Marks of bruising on left side of face. Blood was issuing from the left ear.

Wrist
dislocated.

The right wrist was dislocated.

Effusion
on brain.

Brain:—blood was effused beneath the membranes and into the substance of the brain.

Liver.

Liver, enlarged, but not injured.

Spleen,—
lower end.

Spleen, enlarged, had a rent on lower margin.

The abdominal cavity contained a large quantity of blood.

Death.

Death was almost immediate.

Case No. 6.—Myadhun Kolutani, woman, ætat 20, dissected on 12th October, 1876.

Blow with
mallet.

Nature of violence:—A blow with a massive wooden-mallet.

No
bruises.

Marks of external bruises, none. No bones injured.

No effusion

No signs of ecchymosis, or bruise, found, on dis-

section, among the tissues of the part struck or of any other region of the body.

Spleen not abnormally large; it was ruptured in three places:—one large fissure, 3 inches long, $\frac{1}{2}$ inch deep, is across the convex surface, transversely; two smaller ruptures are on its concave, or gastric, surface: each of these latter is from 2 inches to 3 inches long, and from one quarter, to half, an inch deep.

among
tissues.

Spleen not
large :
three
ruptures—
one on
convex ;
two on
concave.

The abdominal cavity contained nearly all the blood of the body, in a liquid state.

The heart and lungs were both bloodless.

No other viscera injured.

The stomach was distended with a half-digested meal of rice.

Stomach
distended.

Death was immediate.

Death

Case No. 7.—Kandoora Garo, male, ætat 12, dissected on 15th September, 1876.

Nature of violence:—Fall from a tree.

Fall.

Any marks of bruises, which may have been at first present, had been obliterated by decomposition.

Bruises not
discernible.

Spleen, very large, has a rupture, 3 inches long, and from half, to one-third of, an inch deep, on its concave surface.

Spleen,
large,
ruptured
on concave.

The abdominal cavity contained much fluid blood.

Death was immediate.

Death.

Case No. 8.—Jurmoo Ram, male, ætat 13, dissected on 19th June, 1876.

- Fall. Nature of violence:—Fall from a tree.
 No marks of external bruises. No bones injured.
- Effusions. Extensive ecchymosis among muscles of the left side of chest and of abdomen.
- Spleen, ruptured on convex and posterior. Spleen, large and soft, is extensively ruptured along its posterior edge, and on its convex surface. These regions are quite shattered.
 Cavity of abdomen contains much blood.
- Stomach. The stomach contains a small amount of partially-digested food—is practically empty.
 No other viscera injured.
- Death. Death almost immediate.

Case No. 9.—Hurrumul Kolita, male, ætat 50, dissected on 20th June, 1876.

- Fall. Nature of violence:—Fall from a tree.
- External bruises. Extensive marks of bruises on the left side of chest and back. The left ribs, from sixth to tenth, inclusive, are fractured in a line with the axilla.
- Five left ribs broken.
- Eighth rib pierced parietes. There is a wound, through the parietes, about one inch long, and half an inch wide, through which, protrudes the jagged end of the fractured eighth left rib.
- Effusion into muscles. The muscles and tissues of the left side are loaded with extravasated blood.
- Spleen torn by fractured ribs. Spleen :—its convex surface is torn in every direction by the sharp ends of the fractured ribs.

The cavity of abdomen is filled with extravasated blood.

Liver, enlarged, heavy, but not injured. No other Liver. viscera injured.

Case No. 10.—Bhakoroo Konch, male, ætat 35, dissected on 2nd February, 1876.

Nature of violence:—Fall from a tree.

Fall.

Marks of severe bruising over left side of chest, External and, over the left side, and upper portion, of the bruises. abdomen.

No ribs, or bones, broken.

Left lung very congested, especially on its left Left lung and anterior surfaces. On its left surface, there is a congested, small rupture of its substance, half an inch long, and one-third of an inch deep. This fissure is blocked ruptured. up by a firm clot. Only a few drops of blood have Rupture escaped into pleural cavity, from this rupture. filled by firm clot.

Spleen, large and soft, is ruptured transversely Spleen split across its concave (gastric) surface, from anterior in two to posterior margins, through the tissues attaching from the spleen to the pyloric end of the stomach. concave. If this fissure penetrated a little deeper it would completely divide the spleen into halves—an upper, and a lower.

Stomach is distended with a large, partially- Stomach digested, mass of rice ; it is normal, and uninjured. distended.

The wound across the spleen is partially blocked Wound of up by a large clot that has not fully coagulated. spleen filled by clot.

The cavity of the abdomen is filled with fluid blood.

The other viscera, bloodless.

Survived
for 3 hours.

Period of survival:—three hours.

Spleen split
against
distended
stomach.

It will be noticed that in this case, the spleen was split, nearly in two, from the surface which came into collision with the distended stomach. In spite of the extent of the rupture, the man survived for three hours, and a clot formed in the spleen wound. It will be observed that the rupture was through the hilus and its vessels.

Case No. 11.—Motia Cachari, male, ætat 40, dissected on 19th July, 1875.

Gunshot.

Nature of violence:—Gunshot—by a ball out of a smooth-bore musket.

Wounds of
colon:

jejunum,
spleen,
stomach.

The ball entered on the left side of body, below the 11th left rib; it penetrated the descending colon, some coils of the small intestine (jejunum), the spleen, and the cardiac end of the stomach; it finally passed out of the body through the ninth rib, fracturing it at its junction with the cartilage.

In the wound of exit was fixed a piece of the cloth used as a wad. This must have been carried through the body by the ball.

The cavity of abdomen contained much blood.

Survival—
four hours.

Period of survival:—four hours. The period of survival in this case is well worthy of note.

Case No. 12.—Shookeny Mussamut, woman, ætat 35, dissected on 1st January, 1875.

Nature of violence:—Gunshot—by a ball from a Gunshot. smooth-bore musket.

The ball entered on right side of the body, between the seventh and eighth ribs. The liver is perforated by a wound, and is completely shattered, at its left lobe. The stomach is opened by a cut, three inches long, as if a piece has been gouged out. The spleen is perforated by a wound, the left extremity of which corresponds with the wound of exit from the body. From the wound of exit protrudes a piece of fat of the diameter of the little finger.

The wound on the left side—of exit—is about one inch long, and semi-circular in outline; it is about three inches lower down than the wound of entrance.

Case No. 13.—Heho Kolita, male, ætat 13, dissected on 19th February, 1878.

Nature of violence:—Fall from a tree.

Fall.

Marks of severe bruising on the body.

External bruises.

Extensive extravasations of blood are found in the tissues of the scalp, and of the chest and abdomen. No injuries to bones.

Effusions into tissues.

Spleen, not large, or soft, is ruptured transversely across its convex surface. The fissure is about four inches in length, and about one-third of an inch in depth.

Spleen healthy, ruptured on convex.

The abdominal cavity contains much blood.

Both lungs
bruised.

The lungs show marks of severe bruising on their anterior surfaces ; both are of a bright scarlet color. No other viscera injured.

Survival—
six hours.

Period of survival :—six hours.

Case No. 14.—Woochem Garo, male, ætat 30, dissected on 1st January, 1875.

Fall.

Nature of violence :—Fall from a tree.

External
bruises.

Marks of severe bruising over left side of chest, and over outside and front of the left thigh.

Effusion
into tissues.

Extensive extravasations of blood, among the tissues of the regions mentioned above.

Spleen,
large, firm,
ruptured
on convex,
wound
filled by
clot.

Spleen, enlarged but firm, had a slight rupture across convex surface, through its superficial substance, to depth of a third of an inch—and one inch in length. This wound was blocked by a very firm clot. Only a few drops of blood had been effused, which had clotted among the intestines, and were adherent to them.

No signs of
peritonitis.

The intestines were normal, and there were no signs of peritonitis.

Endo-
carditis.

Heart showed signs of endocarditis. The lining membrane was pink, from injection of its small vessels. This appearance extended over the valves, and, for a short distance, into the aorta.

Both lungs
congested.

Lungs, both, were intensely congested.

Survival—
five days.

Period of survival :—five days.

This case is well worthy of being remarked :—

It will be noted, that the wound of the spleen was slight; that only a few drops of blood escaped, which coagulated among the intestines without causing peritonitis; that the spleen was not far from healthy, and made an effort at repair—by the wound becoming blocked up by a firm clot, five days' old, at the time of death.

The period of danger from the spleen wound (shock, hæmorrhage, peritonitis) had passed, during the five days of survival; when, finally, the further progress of this experiment at recovery was stopped, by the patient sinking from the heart and lung injuries, apparently.

Reparative
power exer-
ted by
spleen.

Mode of
death.

Case No. 15.—Polton, male, ætat 45, dissected on 28th April, 1879.

Nature of violence:—Pounding with feet, elbows, &c., of assailants, and blows with native shoes.

Pounding.

Extensive external marks of bruises are seen on the skin of the head, the left side, and back.

External
bruises.

Much extravasated blood is found in the tissues of these regions, on dissection.

Effusions.

Spleen, somewhat soft and enlarged, has a star-shaped rupture, about $1\frac{1}{2}$ inch across, and one-third of an inch deep, on its concave surface. This wound extends into the hilus.

Spleen,
large, soft,
ruptured,
on concave.

The wound of the spleen is partially blocked up by a soft clot.

Clot in
wound.

The abdominal cavity contains a large quantity of effused blood, partially coagulated.

Stomach empty. No other viscera injured.

Period of survival :—two hours.

Survived
for 2 hours.

Case No. 16.—Poornoo Ram, male, ætat 35, dissected on 20th August, 1871.

Blows with
dhao.

Nature of injury :—Blows with back and edge of a dhao.

Incised
wounds of
neck.

There were three deep wounds on the left side of the neck ; one, cutting through the angle of the jaw ; one, dividing all the structures of the neck and the transverse process of the fifth cervical vertebra.

Spleen—
burst—
front edge.

Spleen, very large and soft, a mere bag of blood, had a rupture along its anterior edge.

Abdominal cavity contained much blood, effused beneath, and round, region of spleen.

Stomach was distended with undigested rice.

Case No. 17.—Durma Kolita, male, ætat 28, dissected on 6th January, 1872.

Fall.

Nature of violence :—Fall from a tree.

Abrasions,
Colles's
fracture.

There was abrasion of the skin over chin and left knee, and Colles's fracture of the left wrist.

Lungs con-
gested,
pleural
effusion.

Both lungs superficially congested ; costal pleuræ inflamed, and some dark serum in both pleural cavities.

Spleen
had five
ruptures—

Spleen, large and soft, was ruptured in five places : three fissures were on the external surface, trans-

versely across ; the lower one of these was extensive, and penetrated half through the substance of the spleen ; two ruptures were on the internal (concave) surface, near the lower end.

three on
convex ;
two on
concave.

The abdominal cavity was almost filled with blood.

Survived
for $\frac{1}{2}$ hour.

Period of survival: half an hour.

Case No. 18.—Kankota Surma, male, ætat 12, dissected on 13th June, 1872.

Nature of violence :—Fall from a mangoe-tree.

Fall.

No external marks of injury.

No external
bruises.

Liver large, soft, and bloodless, easily breaking down under the fingers, but not injured.

Liver,
large, fri-
able.

It weighed 45 ounces.

Spleen very large, soft ; weighed 28 ounces.

There were two ruptures of this viscus :—one, about two inches long, on upper end of the convex surface ; the other, a broad, ragged, deep, fissure extended from the lower, to within an inch of the upper, edge of the concave surface, and from the middle of this fissure, a smaller one extended, transversely, across inner surface to the anterior margin, through the hilus.

Spleen,
large, soft ;
weighed
28 ounces ;
ruptures—
one on con-
vex ; one on
concave.

Much blood was effused into the areolar tissue of the hilus, and into the sheaths of the vessels entering at this region.

Blood
in sheaths
of vessels.

The abdominal cavity was filled with blood.

Period of survival :—a few minutes.

Spleen
very large.

The great weight of this spleen, *viz.*, 28 ounces, in a child of 12 years of age, is worthy of note.

Case No. 19.—Shookna, male, ætat 38, dissected on 19th June, 1872.

Fall.

Nature of violence:—Fall from a tree.

Spleen,
had four
ruptures—
three on
convex;
one on
concave.

Spleen, very large and soft, was ruptured in four places:—one transverse rupture, on convex surface, extended from anterior to posterior edge, near middle of the spleen; two other small fissures were near upper end of the convex surface; a fourth, small, fissure was near the upper end of internal surface.

Blood in
abdomen.

The abdominal cavity contained a moderate quantity, only, of blood.

Liver, soft.

Liver was soft and bloodless.

Period of survival:—four hours.

Case No. 20.—Bagsaul Cachari, male, ætat 28, dissected on 28th June, 1872.

Fall.

Nature of violence:—Fall from a tree, on to abdomen.

External tissues decomposed.

Spleen,
had two
ruptures—
one on pos-
terior; one
on concave.

Spleen very large and soft, was ruptured in two places:—one large fissure was at lower posterior edge; the other extended from the hilus to posterior edge, across the concave surface.

Abdominal cavity filled with blood.

Period of survival:—a few minutes.

Case No. 21.—Dobagoo Konch, male, ætat 45, dissected on 18th July, 1872.

Nature of violence:—Fall from a tree.

Fall.

The tissues over right wrist were swollen. The left ribs, from second to sixth, inclusive, were fractured near their angles. The broken end of the third rib had pierced the left pleura. There was Colles's fracture of right wrist.

Five left ribs fractured—pleura pierced—Colles's fracture.

Spleen, large and soft, was ruptured in three places:—two ruptures were on the internal surface; one extended transversely across, midway between the hilus and upper edge, from posterior to anterior margin, and, round this, on to the external surface, for about three quarters of an inch; it gaped about two inches wide; from its widest part, near hilus, extended a superficial rupture, one and-a-half inch long, and half an inch deep. On the external surface was a third rupture, extending from the posterior edge, to within a short distance of the anterior margin.

Spleen large, soft; had three ruptures—two on concave; one on convex.

Abdominal cavity contained a large quantity of blood.

Period of survival:—three hours.

Case No. 22.—Jobun Shaba, male, ætat 35, dissected on 25th July, 1872.

Nature of violence:—The injuries were inflicted by a tiger.

Injured by a tiger.

Two wounds, on each side of the neck, extended

Wounds of neck.

down to the spine. There were about twelve other wounds on the back and left side.

Scapula
fractured.

The left scapula lay, fractured in two places, at the bottom of one of these wounds.

Vertebræ
crushed.

The sixth and seventh cervical vertebræ were crushed to pieces.

Lungs
contused.

Both lungs were contused.

Spleen.

Spleen was wounded, and protruded through a wound of the parietes.

Abdominal cavity contained a small quantity of bloody serum.

Case No. 23.—Ram Hera, male, ætat 30, dissected on 16th November, 1872.

Fall.

Nature of violence:—Fall from a tree.

Spleen,
ruptured
on con-
cave.

Spleen, very large and soft, had a rupture transversely across inner (concave) surface, from anterior to posterior edge, about one inch from upper margin. This fissure was about half an inch broad, and the

same in depth. Spleen weighed 30 ounces.

Liver large. Liver large, much resembled the spleen in appearance.

Abdominal cavity contained a large quantity of blood.

Period of survival:—six hours.

Power of
exertion
after in-
jury.

History.—The man fell from a tree, about 18 feet high, his left side striking the ground. He called out for assistance, and with it, walked home—about 200 yards.

He remained conscious, and able to talk, for about an hour after the fall. He then became insensible, and remained in that state for five more hours, when death ensued.

Conscious
for one
hour.

He had suffered from fever and jaundice a short time before.

Jaundiced.

Case No. 24.—Dosaram Kolita, male, ætat 20, dissected on 20th March, 1873.

Nature of violence:—Severe blow on the body with the yoke of a native plough, the bullocks having bolted.

Blow with
yoke of a
native
plough.

Spleen, very large and soft, weighed 44 ounces, after the blood had been washed away from it. The spleen was, practically, split in two, by a large, ragged, wound, which passed through the entire thickness of the viscus, transversely, at junction of the upper and middle third; these two halves were merely held, loosely connected by a couple of narrow bands of spleen-substance. This fissure was from both surfaces.

Spleen,
large, soft,
weighed
44 ounces
was split
in two
transverse-
ly.

Abdominal cavity contained much dark blood, and clots of blood were among the intestines.

Liver, large and soft, had a number of nodules on it, on right under surface.

Liver,
large, soft

Heart, and lungs, pale, and bloodless.

Viscera
bloodless.

Period of survival:—a few minutes.

History.—The man was ploughing, with a pair of bullocks, in a native plough. The bullocks took

History

fright, and made a stampede; the man was knocked down, and struck severely on the side by the plough-yoke. Efforts, made to rouse him, were unavailing; he never regained consciousness; but died in a few minutes.

Case No. 25.—Budoo Konch, male, ætat 30, dissected on 11th September, 1873.

Pounding. Nature of violence :—Pounding with hands, knees, elbows, &c., of assailants.

Bruises. Extensive bruises over the whole body.

Lung congested. Left lung intensely congested. No extravasation of blood in the tissues over the region of spleen.

Spleen ruptured. Spleen ruptured.

Abdominal cavity contained an enormous quantity of blood.

Case No. 26.—Kaseekata, male, dissected on 27th May, 1864.

Blows. Nature of violence :—Blows with a lathi (heavy stick) probably.

Spleen ruptured. Spleen ruptured.

Abdominal cavity contained a quantity of fluid blood, in the region of the spleen.

Case No. 27.—Behoo, male, ætat 15, dissected on 20th July, 1869.

Blow with a stick. Nature of violence :—Sharp blow with a stick.

Linear A very narrow bruise, about 5 inches, to 6 inches,

long, was visible across the left side—of no apparent bruise on left side. severity, so far as external appearances were concerned.

Spleen very large, and soft; weighed 28 ounces; Spleen—28 ounces; ruptured on convex. it had a rupture across its convex surface, about 4 inches in extent, exactly corresponding to the external mark of bruise, in situation and direction.

Abdominal cavity contained a large quantity of blood, among which were some clots.

The weight of this spleen is noteworthy, 28 Spleen large for a child. ounces, after it had been drained of blood, in a boy of 15 years.

Case No. 28.—Obi Ram, male, dissected on 23rd December, 1869.

Nature of violence:—Fall from a tree. Fall.

There was a punctured wound of the scalp, and External bruises. there were found extensive bruises of this region, and of several parts of the body, including the region over the spleen.

Spleen was very soft and enlarged; it was split Spleen split in two. into two parts.

Abdominal cavity contained a large quantity of effused blood.

Case No. 29.—Manoo, male, dissected on 6th January, 1871.

Nature of violence:—Uncertain (probably a fall, or blows).

No external
bruises.

No signs of bruising could be discovered on any part of the body.

Spleen,
ruptured.

Spleen very diseased, ruptured; it would have been easily injured by a slight blow.

The abdominal cavity contained much dark, fluid, blood.

Case No. 30.—Kola Show, male, ætat 38, dissected on 6th May, 1871.

Fall.

Nature of violence:—Fall from a tree.

All left ribs
fractured.

All the ribs of left side are fractured, some in two or three places; all are fractured through the shaft; and some at the angle also. Two or three have pierced the pleuræ and wounded the left lung.

Five right
ribs frac-
tured.

The right ribs, from second to sixth, inclusive, are fractured at about 2 inches from their sternal ends; the second rib is fractured near its angle, also.

Blood in
pleuræ.

The cavities of both pleuræ contain effused blood.

Left lung
pierced.

The left lung is pierced, in three places, and its surface is covered with large, dark, clots. It is inflamed, and attached to the costal pleura by recent, soft, adhesions.

Right lung
pierced,
congested.

The right lung is congested; it is pierced by the fourth right rib; the wound is closed by a clot. This pleura contains about two ounces of blood.

Spleen
ruptured
on convex.

Spleen is ruptured, longitudinally, along convex surface, from upper nearly to lower end. This rent is deep and gapes about 2 inches wide at its upper

end, but becomes more superficial towards its inferior end.

Abdominal cavity contains large quantity of blood.

Kidneys.—The right kidney is ruptured, transversely, near the hilus. About half an ounce of blood is effused round it, into the areolar tissue. The left kidney shows marks of contusion, in one or two places; but no blood is effused in its neighbourhood. The blood effused from the rupture of right kidney lay behind the peritoneum, round the kidney, apart from the large amount of blood inside peritoneum, from the ruptured spleen.

Kidneys—
the right—
ruptured,
blood
effused.
The left,
bruised.

Case No. 31.—Goomaroo, male, dissected on 31st May, 1871.

Nature of violence:—Blow with a bamboo stick. No external marks of bruise.

Blow with
stick.

Subcutaneous effusions of blood were found over the region of the lower right ribs, and corresponding ecchymosis was found on the costal surface of this pleura.

Effusions
into tissues.

Right lung, highly congested towards base; about 8 ounces of bloody serum, in this pleural cavity. About the same amount, in left pleura.

Lung con-
gested;
effusion
into pleura.

Spleen, enlarged and very soft; appears to be, a mere bag of blood; ruptured.

Spleen
ruptured.

Liver large and soft.

Abdominal cavity contains a large quantity of blood.

Period of survival:—two hours.

Case No. 32.—Shookroo Konch, male, dissected on 24th June, 1871.

Fall. Nature of violence :—Fall from tree.

Spleen—
ruptures—
concave. Spleen, very large and soft, had several longitudinal ruptures on internal surface.

Abdominal cavity filled with blood.

Liver, soft. Liver, large and soft, broke down easily under fingers, during handling; not injured.

Case No. 33.—Narah Koiburto, male, ætat 30, dissected on 25th February, 1879.

Pounding. Nature of violence:—Pounding with feet, knees, elbows, &c., of assailants.

No bruise marks. No marks of bruises on the skin.

No effusion into tissues. On dissection, no extravasations of blood could be discovered among any of the tissues or muscles.

Spleen firm. Spleen, firm, slightly enlarged. On its convex surface, where it had been in contact with abdominal wall, a patch of dark purple ecchymosis was found, 3 inches long, 2 inches wide, penetrating from one-third, to half, an inch, into spleen tissue. The dark color of this bruised patch contrasted, forcibly, with the lighter, reddish-brown, color of the rest of spleen tissue.

Left lung The left lung was severely congested over the

surface in contact with the chest wall. Towards congested and bruised, the base, the anterior surface of this lung was pink, from ecchymosis.

History.—The man was sent to hospital by the police, on 21st February, 1879, reported to have History—Symptoms on admission. been injured on the 20th. No external marks of injury could be discovered. He was able to walk from the dhuli, into hospital.

During the next four days, the chief symptoms Subsequent symptoms. were :—fæcal and bilious diarrhœa, and vomiting, both of which symptoms subsided on the second day ; local pain over spleen, increased by motion or pressure ; permanent rise, of about 3 degrees, in temperature ; and steadily increasing congestion of the left lung.

He died on the evening of the 24th (*i. e.*, four days after the injury).

The lung symptoms seem to have caused the fatal termination.

This case is discussed, at greater length, in Chap- Vide Chapter II. ter II.

Case No. 34.—Mohiram, male, ætat 39.

Bruise of spleen—recovery.

History of case.—Sent to hospital on 29th March, Bruise of spleen ; recovery. History. 1879, reported to have been injured, in a quarrel, on the previous evening.

He reports that he was thrown down, and pounded Pounded with feet, knees, &c. with the knees, elbows, &c., of assailants.

On admission,—complains of severe pain over re- Symptoms.

Progress of case. gion of spleen. The edge of the firm spleen can be felt below the left floating ribs.

Symptoms due to spleen injury. No sign of discoloration of bruising can be detected on the skin, though this is tumefied over the left lower ribs ; skin cold—pulse feeble and quick—much exhaustion ; some fæcal diarrhœa, but no vomiting ; abdomen soft, deep pressure caused no pain, except over spleen region.

During the next few days, the symptoms remained much the same.

Absence of lung injury. No sign of lung mischief—percussion, and the stethoscope, showed both lungs healthy. During the succeeding week, the temperature permanently remained about two degrees above the normal, and the patient complained of severe pain over the spleen region ; deep pressure over this region caused faintness and sickness. The exhaustion continued. There was an absence of prominent symptoms, probably due to the fact that no other viscus (in addition to the spleen) was injured.

Recovered in 18 days. He left hospital, on 16th April, *i. e.*, 18 days after the injury, and was soon in good health.

The diagnosis of this case has not yet been verified by dissection.

Case No. 35.—Chunkea Sooba, male, ætat 32, dissected on 19th October, 1878.

Rupture of spleen-substance inside the intact capsule (Class II).

Survival for four days.

Capsule of enormous thickness, from chronic inflammatory changes; slow softening of this capsule, during the days succeeding the injury; bleeding into the capsule; coagulation, in situ; distention of capsule by large globular clot-mass; eventual rupture of softened capsule, and of contained clot-mass, by muscular action of abdominal walls compressing the spleen-mass against resisting spine—immediate death, at the close of the fourth day after the primary injury.

Thick capsule;
bleeding into capsule;
rupture of capsule and clot-mass by muscular action.

The whole history and details of this interesting and instructive case are given, at length, in Chapter III. They are too voluminous for full recapitulation.

For details vide Chapter III.

Case No. 36.—(Name unknown), male, ætat (about) 35, dissected 23rd July, 1876.

Nature of violence:—Blow with bamboo stick. No marks of bruise on the skin, which is, itself, dark colored.

Blow with stick.
No external marks.

On dissection, extravasated blood is found among the tissues and muscles over the left side of chest and abdomen.

Effusion into tissues.

Spleen, large and soft, was ruptured across convex surface.

Spleen, ruptured.

Abdominal cavity filled with blood, partially coagulated, in some regions, among the intestines.

Abdomen—blood.

Period of survival :—six hours.

History. After receiving the beating which caused the eventually fatal injuries, the man got up from the ground, resumed his load (two bundles of dhan, slung at the ends of a bamboo), and carried it for some distance ; he then complained of sickness and faintness, and lay down. He remained conscious, and gradually sank into collapse and death.

After the injury—
carried
load.

Case No. 37.—Simbi Garo, male, ætat 40, dissected on 21st August, 1879.

Pounding
with feet,
knees, &c.

Nature of violence:—Pounding with feet, knees, elbows, &c., of assailants.

Death
some years
after.

Body dissected some years after the assault, death having occurred from diarrhoea, which had no connection with the assault, or the consequent injury.

Spleen—
marks of
old injuries
found ;

Marks of old injury were found on the spleen.

white—
puckered—
patches on
convex.

The viscus was firm, and about normal in size. On its convex (external) surface, were found two white patches, irregular in outline ; one about two inches across, the other about one inch in each diameter. Over these patches the capsule of spleen was dense, white, and leather-like. These patches penetrated about one-fifth of an inch into spleen-substance. On their surface, the patches were puckered ; they suggested the idea of irregular contraction having taken place.

These
patches
seem

They were divided, by a sharp line of demarcation, from the rest of spleen capsule, whose glisten-

ing, semi-transparent, appearance strongly contrast-^{remains of old bruises.}
 ed with the rough, puckered, white patches. No
 signs of injury of any other viscera.

History.—The man was assaulted, and injured, by ^{History—}
 pounding with the feet, knees, elbows, &c., of sever-^{Previous}
 al assailants, in June, 1876. He suffered from ^{injury by}
 severe pain over the region of the spleen, and was ^{pounding}
 ill, for 20 days, afterwards. During the first two ^{with feet,}
 days, there was some purging and vomiting; there ^{knees, &c.}
 was great exhaustion, for many days. One of the ^{—illness.}
 assailants, Bali Ram, furnishes this history. In ^{Symptoms.}
 this case, the man did not come under skilled
 observation at the period of injury, but the history
 of the assault, and of the consequent pain and
 illness, is complete.

There seems little cause to doubt that these ^{Connection}
 marks, found on the spleen, were the contracted, ^{of marks—}
 fibrinous, exudations resulting from localised inflam- ^{injury.}
 mation following a bruise.

For further notes on the rationale of the above ^{Details in}
 case, *vide* Chapter II. ^{Chap. II.}

Case No. 38.—Shombaroo Sheikh, male, ætat 19, Fall.
 dissected on 30th August, 1879.

Nature of violence :—Fall from a platform, 8 feet
 3 inches in height : the left side of abdomen, about
 the level of the umbilicus, impinged on a blunt
 bamboo-stump in the ground.

The fall occurred at 3 A. M. ; he died at 11 A. M. — ^{Survived}

for seven
hours.

seven hours after. The body was then sent in for examination.

Mode of
death.
Bruises
and
effusions
into
tissues.

He is reported to have been conscious for some hours, and to have sunk from collapse. There was a superficial wound, 3 inches by 2 inches, on the left side of abdomen, about the level of the umbilicus. In the muscles beneath, and round, this, there was much extravasated blood.

Spleen,
healthy,
had a
patch of
pink
ecchymosis
on concave.

Spleen, normal in size and in firmness, lay entirely behind the shelter of the lower ribs. On its concave surface, was a patch of pink discoloration, 3 inches by 2 inches, extending one-third of an inch deep into the substance of the spleen.

Stomach
distended;
double
rupture at
cardiac
end.

The stomach was still distended with a large meal of rice, at the time of dissection. At its cardiac end, where it lay in contact with the firm spleen, were two ruptures, close together, each sufficiently large to admit the tip of the forefinger.

Contents
escaped.

A few grains, only, of rice had escaped into the peritoneal cavity, together with a few drops of blood.

Coats of
stomach
not
diseased.

There were no signs of disease or ulceration of the coats of the stomach, either at the region of the rupture, or elsewhere; they were normally thick at the edges of the ruptures.

Both sur-
faces con-
gested
round the
ruptures.

The mucous membrane was reddened for about two or three inches, and the external, serous, coat finely injected for about one inch, round the region of the ruptures.

Period of survival:—seven hours.

Survived
7 hours.
Comments
on the case.

In this case, the normal, firm, spleen, and a healthy, but distended, stomach, were brought into violent collision ; the result being that the spleen—on account of its firm, healthy, condition—was merely bruised, while the distended stomach suffered double rupture.

In the present case, the fatal ending, and the period at which this occurred, seem to have been determined, chiefly, by the rupture of the stomach and the escape of some of its contents into the abdominal cavity. For, as will be seen by a reference to Chapter II, it is not in the nature of a bruise, merely, of the spleen to cause a fatal result in such a brief period of time as alone elapsed, in this case, between the accident and death.

Fatal ending due to ruptures of stomach and escape of its contents.

For further discussion of this, and similar cases, the reader is referred to Chapter II.

Vide
Chap. II.

Case No. 39.—Keddala, male, ætat 54, dissected on 23rd February, 1880.

Nature of violence :—A fall to the ground while stepping over a shallow ditch, 4 feet wide, $1\frac{1}{2}$ feet deep.

Fall to ground.

No marks of bruise on any portion of the skin-surface.

No bruise marks.

No extravasations of blood among the tegumentary tissues, or the muscles of any region of the body.

Spleen. The spleen was large, soft, and dark in color.

Old adhesions. It was adherent, by nearly the whole of its external surface, to the parietes of the abdomen ; this connection being established by numerous bands of tough, white, fibrinous matter. These adhesions were of ancient date.

Double rupture on concave. This spleen was ruptured, in two places, on its concave (inner) surface.

Region of the fissures. One fissure starts from the anterior edge, at junction of upper with middle third, and runs obliquely down to the hilus, where it ends. The second ruptures runs obliquely down and back across the middle of the concave surface, from anterior to posterior edge ; in front of the hilus, it is a mere fissure—behind the hilus, it assumes the form of a gaping, starred, cavity.

The ruptured spleen is bloodless, wizened, collapsed, and puckered.

Size—weight. It measures 8 inches in length, 5 inches in width, and from $\frac{1}{2}$ inch to 2 inches in width.

It weighs, after being washed, $15\frac{1}{2}$ ounces.

Blood in abdomen. The abdominal cavity contains a large quantity of dark, fluid, blood ; a few clots are found among the coils of the intestines. All the viscera are bloodless.

Stomach full. The stomach is considerably distended with a mass of partially-digested rice.

It is not injured.

Survival for half an hour.

History:—This aged, mussulman, beggar-man, while crossing the above-described, shallow, ditch, fell with his left side against the edge of the ditch. He lay senseless and never spoke or rallied, after the first two or three minutes. While being carried to hospital, he died, about half an hour after the fall.

The spleen, in this case, though large and soft, was, by no means, so to an extreme degree, nor was it very heavy, after rupture and loss of blood.

It seems to have been crushed, by the concussion of the fall, against the hard, food-distended, stomach, which determined the occurrence of the two extensive ruptures on the surface (concave, gastric) of contact of the spleen with this stomach.

Possibly, the fact that digestion was going on, at the period of the occurrence of the injury, may have caused the spleen to be temporarily distended to an unusual degree with blood (as occurs during digestion); so that this distention of digestion may have been superadded to the condition of considerable permanent, malarial, hypertrophy and softening; and, together, these factors may have been sufficient to determine the severe nature of the injuries which resulted from a degree of violence, apparently, only moderate.

APPENDIX.

CASE ILLUSTRATING POWER OF RESISTANCE TO INJURY
POSSESSED BY EVEN AN ENLARGED, SOFT, MALARIAL SPLEEN.

Rupture of intestines, from a fall—entire escape of a large, soft, spleen

Sheikh Ram—ætat 20, dissected on 20th February, 1880.

Nature of violence :—Deceased, while carrying a heavy plan-
tain tree on his shoulder, stumbled, and fell to the ground, the
tree falling across his back. He fell, in a prone position, on to
the abdomen and face. The road, on which he fell, was fairly
even, and without any marked projections.

Marks of bruise on skin :—None on any part of the body. No bruise
on skin.

No extravasations of blood were found, among the external
tissues, or muscles, on any region of the body, on dissection. No effusion.

The spleen was moderately enlarged, soft, and darkly pigmented. Spleen not
It showed no sign of any injury. hurt.

Liver—somewhat enlarged, and very dark colored—not injured. Liver.

Stomach—empty—not injured.

Intestines :—The coils of the jejunum and ileum were matted
together, by masses of recently-effused, imperfectly-coagulated,
lymph, in which are entangled small clots of blood—
Intestines.
Rupture of
ileum.

About 15 inches from the ileo-cæcal valve, there is a transverse
rupture through the coats of the ileum, large enough to admit
the end of the forefinger. The edges of this wound are swollen
and sloughy; there seems to have been no successful attempt
to glue them together with lymph deposits. The gut, in the
region of the wound, contains much solid faecal matter, some
of which has escaped through the rupture, and lies among the
coils of the adjacent intestine. Nature of
injury.

Appear-
ances.

There is deep-purple discoloration of the peritoneal covering of the whole of the ileum and jejunum.

Fæcal
matter
near
rupture.

The ruptured portion of the gut is about the level of the upper edge of the pubic bone. It seems probable, that,—shocked between the contained hard fæcal matter on the inside, and the upper edge of the pubic bone on the outside, as the heavy tree

Rationale
of injury.

fell across the body—the coats of the intestine gave way, and the above-described rent ensued. The shock, to the whole abdomen and its contents, was, probably, severe and diffuse—and the entire escape of the large, soft, malarial spleen is worthy of

Note—gut
injured,
spleen
escaped.

note ; the more so, as there ensued rupture of the small intestine—a viscus, relatively very rarely injured, compared with the spleen.

Among the cases of injury to the spleen, recorded in the treatise to which this is appended, in only one case, out of 39, was the intestine injured ; yet, in the present instance, a fairly rupturable, diseased, spleen entirely escaped, while the mobile, well-defended, small intestine gave way.

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